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Science & Technology

USSR: Computers

10
93
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28 JULY 1987

SCIENCE & TECHNOLOGY

USSR: COMPUTERS

CONTENTS

SOFTWARE

APPLICATIONS

EDUCATION

/13046

PRAVDA VIEWS ROLE OF INFORMATION TECHNOLOGY

Moscow PRAVDA in Russian 23 Jan 87 pp 2-3

[Article by Doctor of Philosophical Sciences Professor A. Rakitov under the rubric "Questions of Theory": "The Introduction of Information Science Into Society and the Strategy of Acceleration"]

[Text] At the CPSU Central Committee conference on the acceleration of scientific and technical progress M.S. Gorbachev, speaking of the information science industry as a catalyst of scientific and technical progress, noted that it entails revolutionary changes in production. What is the nature and significance of these changes? What will they mean for us in the long term? These questions are now coming to the fore.

The unusual "diversity" and also ease of operation of modern computers, especially personal computers, making them accessible to everyone, even those unfamiliar with the subtleties of professional programming, have ensured their rapid proliferation. This process has become known as computerization. It is taking place in the sphere of production forces and relates to their technical component. A far more profound process is built up on this basis--the large-scale introduction of information technology (informatizatsiya), covering all aspects of society's life. It is a question of systematic reorganization and improvement, of increasing the efficiency of socially significant activity on the basis of the use of modern computer technology and information systems.

It may be said that the introduction of information technology is comparable, in terms of its worldwide historical significance, with industrialization, which began approximately three centuries ago and changed beyond recognition not only production, but the entire face of society as it was then, the way of life, and the nature of culture. The use of machines, steam engines, and other technical innovations increased labor productivity enormously and enhanced man's physical might by thousands of times. But industrialization scarcely had any effect on that very important sphere of human activity--the intellectual sphere, mental labor. Spiritual creativity, theoretical research, and the management of society and production took place on the same material basis as before industrialization.

Even in the early stages of computerization, a significant proportion of computers were used for the automation of industrial production, and only a small

proportion to increase the efficiency of mental activity. Yet the development of material production itself, especially with the onset of the scientific and technical revolution, demanded an ever increasing volume of knowledge and an increasing diversity of information, which is needed in order to take complex, prompt, and effective decisions in an ever more complex world. This meant that in the most developed industrial countries, the number of people employed in the so-called information sphere has increased steadily. This situation acts as a brake on social and scientific and technical progress, diverting a significant proportion of resources from the sphere of material production into the sphere of information activity.

An important factor which makes the introduction of information technology in society an urgent necessity is the limited nature of raw materials, energy resources, and economic and human resources. In the bourgeois consciousness, this fact has been reflected in a series of theories proclaiming the inevitable slowing down of social, scientific and technical progress and the decline of production down to the level of zero growth, as well as in direct calls for mankind to go into reverse. Conversely, modern Marxist-Leninist thought sees an indissoluble link between the resolution of the current and long-term tasks facing the socialist world and the acceleration of socioeconomic development.

But how can acceleration be compatible with the objectively limited nature of resources? Obviously it is necessary to improve all forms of production, introduce new, "sparing," waste-free technology, minimize expenditure of raw materials and energy losses, and make efficient use of human resources, which is impossible without the accelerated development of scientific knowledge and its introduction into practice. This in turn requires the adoption of profound, scientifically substantiated political decisions of a revolutionary nature. Not for nothing did V.I. Lenin note: "Politics must take precedence over economics. To think differently is to forget the basics of Marxism" (Complete Collected Works, Vol 42, p 278). Thus the rapid, preferential growth of all types of scientific knowledge, above all sociopolitical knowledge, and all types of information is a precondition for the acceleration of progress. In present conditions the winner in the historical competition will be whichever socioeconomic system has the higher quality information at its disposal, produces it more rapidly and in larger volumes, and uses it more effectively to achieve its goals.

It is therefore a question of creating fundamentally new information resources for mankind. Information, including sociopolitical, scientific, technical, and general cultural knowledge, is the only type of resource which in the course of mankind's progressive development, far from being exhausted, actually increases, improves in quality, and at the same time promotes the more rational, efficient utilization of all the other resources, their conservation, and in a number of cases their expansion and the creation of new ones.

Computerization and the introduction of information technology in society mark the onset of a new stage of the scientific and technical revolution. It can be characterized as the scientific and technological stage. The first characteristic of this stage is that scientific knowledge begins to be used increasingly not only in order to create fundamentally new machinery, but also

to develop radically new technologies. Unlike traditional technological forms, they are based on a systemic approach presupposing the mathematical modeling of processes and the processing and utilization of vast quantities of data. This makes it possible to take into account all resource expenditure, the influence of concomitant factors, interaction with the environment, and far-reaching social consequences. Another characteristic of the scientific and technological stage is the sharp increase in the role of the human factor and the creative activeness of the person taking crucial decisions. Contrary to the arguments of the advocates of technological pessimism, modern technology, by freeing the human intelligence from routine operations and multiplying the quantity and diversity of information available to him, is a powerful factor for the rehabilitation and stimulation of creative activity. Thus human creativity engenders sophisticated machinery and technology, and they in turn lead to the buildup of mankind's intellectual resources. This dialectical interaction contains a powerful reserve for the acceleration of socioeconomic progress.

At the same time it is a mistake to think that this process is proceeding smoothly in our society. Because of a number of factors--conservatism, bureaucracy, incompetence, lack of understanding of the advantages of computerization, fear of competition from "intelligent" machines--computerization and the introduction of information technology come up against significant difficulties and against veiled and sometimes open resistance. Moreover, industry, agriculture, and management systems are still only poorly prepared for the application of the new computer and information technology. It is not a matter of "tacking on" computerized and automated information systems to the existing traditional manufacturing processes and forms of management, which is totally ineffective and only compromises the idea of computerization (suffice it to recall the numerous failures involving the introduction of automated control systems in the recent past), but of a radical and even revolutionary change in the technology and structure of production and management. Only in this case will computerization produce fundamentally new results.

Of course, one should not expect scientific and technical progress to have only positive consequences. In the socialist society, nobody has an interest in structural unemployment, the creation of a reserve army of labor, or the inefficient utilization of working people's skills and creative potential. But rapid, sometimes radical changes in the machinery and technology base will inevitably lead to the obsolescence of existing production experience and skills and a change in the skills required in virtually all professional categories and age groups. This fact must be foreseen and taken into account in statewide, sector, and local plans for systematic retraining and the acquisition of new skills for almost all categories of working people. Otherwise the benefits of computerization will be reduced. Moreover there is also the possibility of such undesirable social consequences as a shortage of skilled manpower in some regions and sectors and a surplus in others.

The activation of the human factor demands a high level of information about the achievements of science, engineering, and technology. This can be ensured only on the basis of the creation of well thought out, well organized state, regional, and sector information systems. It must be said that existing

systems for the transfer, storage, and utilization of scientific and technical information, which have grown up over the last 3 decades, have themselves become largely obsolete. Substituting so-called secondary information for the flow of original research information, they not infrequently erect barriers between the author and the consumer of scientific ideas, inventions, and discoveries, complicate the process of acquiring information, and thereby devalue it. In present-day conditions, when information is not only created rapidly, but rapidly becomes obsolete, this is quite impermissible.

It should also be taken into account that the desire to consult information systems does not arise spontaneously. It arises and is cultivated as a result of an active attitude to information. Without going into detail, let us note: A system of measures on a statewide scale is needed, aimed at ensuring that a profound understanding of the need constantly to renew experience and acquire new knowledge penetrates all strata of our society.

The introduction of information technology in general educational and vocational schools and VUZ's creates the prerequisites for the emergence of a new "computer generation." Over the next 15-20 years cadres who have mastered the computer culture will begin to arrive in all spheres of the national economy and management and in cultural and scientific research institutions. For them, interaction with the new information technology will be as habitual and natural as work with traditional machinery and technology was for earlier generations. The "computer generation" will not only know how to program and make free use of the new computer technology, but will know how to use it to tackle practical tasks--production, social, and cultural tasks.

All this poses a series of complex ethical and legal problems associated with the production and application of information. The need may arise for the establishment of precise legal restrictions barring the spread of misinformation or the use of knowledge to the detriment of man and society. Educational tasks will also become markedly more complex. It should be said frankly that the study of these problems has scarcely begun in our country. In the capitalist countries which have also embarked on the path of the large-scale introduction of information technology, it is often asserted that it leads to the alienation of people, the destruction of social ties, and the so-called "computer isolation." On this subject one can note: Everything depends on what decisions are taken, by what means they are implemented, and what final strategic goals society sets itself.

In the conditions of socialism the introduction of information technology is called upon to promote the strengthening of social ties and the cohesion of production collectives, while at the same time creating the conditions for the all-around flourishing of the personality and the development of every person's creative individuality. It could have a powerful effect on the entire social sphere, housing construction, the process of planning cities and residential blocks, the organization of leisure, self-education, the organization of family life, preventive medical work, and so forth. The growth of the general level of information among the population and the possibility of using developed information systems and personal computers to obtain various kinds of consultations, including medical and pedagogical consultations, at home and

to organize new production work at home will help to considerably alleviate the position of family women, improve children's education, and ameliorate the general regulation of family life.

The combination of the latest achievements in the sphere of computer technology, means of communication, telecommunications, and so forth will have a significant influence on the pace and form of access to the highest cultural values. Contrary to bourgeois propaganda statements, the socialist society, in the conditions of rapid introduction of information technology, will be able to offer all its citizens the broadest possible access to all the achievements of world culture.

Of course, these general propositions do not deliver us from the need for further in-depth study of the process of introducing information technology. This type of research now acquires particular relevance. Since the early eighties, all the industrially developed countries have adopted and have begun to implement, on national and regional levels, programs for the creation of fifth-generation computers and third-generation robots, which envisage the utilization of the theory of artificial intelligence. The implementation of these projects could present mankind with unexpected, unpredictable consequences. That is why Japan, the United States, and the West European countries have begun to pursue research on a broad front into the introduction of information technology in society, and to found corresponding scientific institutions. But their experience, while it merits careful study, cannot be mechanically transferred to our country, since in the socialist society the process of introduction of information technology and computerization is taking place in fundamentally different economic, political, social, and cultural conditions.

In order to avoid possible miscalculations and errors in the leadership of the sociopolitical and general cultural machinery involved in the process of the introduction of information technology, it is extremely necessary, in our opinion, to form in the very near future, within the structure of the Academy of Sciences, a center for the study of the introduction of information technology in society. Since the process of introduction of information technology is complex, contradictory, and dynamic, its study cannot be confined solely to general conclusions and abstract recommendations. It should take place within a system of integrated planning with the aim of developing a methodology and creating the scientific foundations for large-scale projects in introducing information technology in various aspects of social life, taking into account the interconnection and interaction of technical, economic, social, psychological, cultural, political, and other factors.

Since hypertrophy in scientific research has long demonstrated its bankruptcy, the proposed center is conceived in terms of an institution which is in the highest degree up-to-date, compact, and staffed with highly-skilled specialists. Its work must be based on targeted functional programs oriented toward the resolution of practical problems in the introduction of information technology and on the principles of the financially autonomous organization of scientific research. Such a center could coordinate planning work on the introduction of information technology in society at sector, regional, and

local levels, and at the same time propagandize the achievements and prospects of information technology.

The resolution of the question formulated here must not be delayed or postponed, since the tactics of "lagging behind and then making up for lost time" are incompatible with the strategy of acceleration.

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SOCIALIST-BLOC CONFERENCE ON SMALL-COMPUTER DEVELOPMENT

Tashkent PRAVDA VOSTOKA in Russian 29 Nov 86 p 1

[Unattributed article]

[Excerpt] To sharply accelerate mass introduction of small computers into the economies of member-countries of the Council for Mutual Economic Aid; to expand cooperation in developing and producing such computers and preparing software for them, in order to make them equal in quality to the best world models--these are tasks which computer-technology specialists from the fraternal countries discussed at an international conference which concluded in Samarkand on November 28. Leading designers of control computers determined main directions for development of small computers and of peripheral equipment for them. They approved a plan for supplying materials and equipment for joint developments which are to be carried out, and set deadlines for their completion.

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LONG-AWAITED COMPUTER

Moscow TEKHNIKA I NAUKA in Russian No 12, Dec 86 pp 17-19

[Article by S. Mindelevich under the "Why Has It Not Been Introduced" rubric: "Long-awaited Computer"; first three paragraphs are TEKHNIKA I NAUKA introduction]

[Text] In the 12th Five-Year Plan it is necessary to fully satisfy the needs of the educational process in computer technology. We must create approximately 130,000 work stations equipped with personal computers and terminals.

This is from the plan of the CPSU Central Committee: "Basic Directions in Rebuilding Higher and Secondary Specialized Education in the Country".

For the first time, an analog minicomputer has been created that is accessible to every student to work on. This equipment has been recognized repeatedly by medals from the VDNKh [USSR Exposition for Achievements in the National Economy]. The developers are receiving a great many requests for it: it can be used both in scientific research as well as in education. But it still has not been put into series production.

Simple as a Calculator

Any contemporary engineer, having "created" some part or technological process on paper, in principle can model it to reveal defects even before it is "cast in iron". Modern computers make this possible.

However, the number of engineers using them is generally still paltry. Aren't there enough comptuers? Indeed, computers frequently stand idle. Every now and then announcements are seen in the newspaper: "The organization is offering machine time on computer type..." It is obvious that the workers in this organization are not racing one another to the computer (also see TEKHNIKA I NAUKA 1986 No 4 article "Computers Without Contact" -- Ed.). The main reason is that many people are still not prepared to "cooperate" with them. They are not prepared equipment-wise or psychologically.

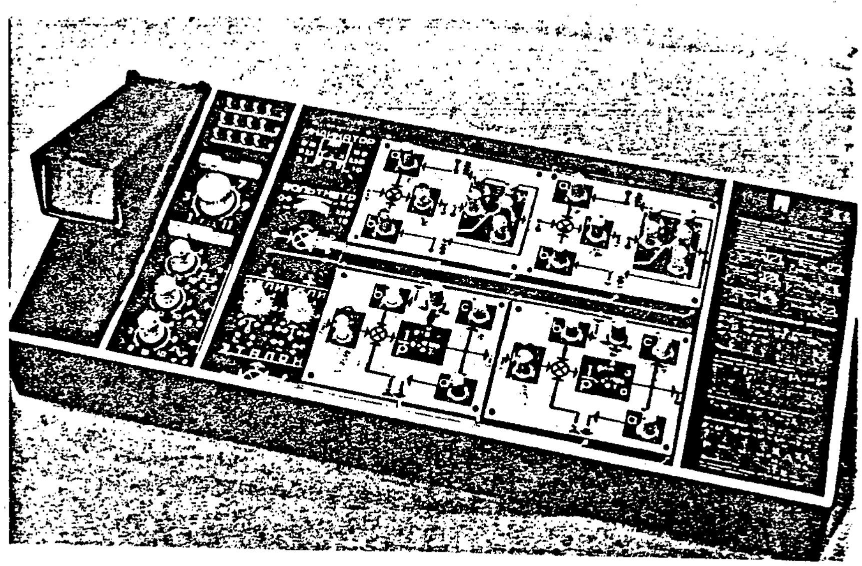
At present, direct contact with a computer is difficult, requiring a knowledge of machine language, the ability to program, practice in working with the display... There are not enough programmers--these "translators" from human language to machine language--and their production plans are sometimes determined for a year ahead. Who can help the engineer practically to put

together a program for solving problems that are relatively simple for a computer?

Courses in the fundamentals of informatics and programming are currently being introduced in nearly all higher institutes of learning and secondary schools. However, there is a vast distance between knowledge of the basics and the ability to work on a specific computer. Indeed, each type of machine has its own operating rules and, frequently, its own "language". Mastering this requires so much time and effort! And this is personal time, since the engineer most often has to acquire the new knowledge in addition to his primary work.

No, this is not the way. It is time to stop adapting to the computer; it is necessary for the computer to adapt to man's capabilities. Only then, when "cooperation" with it becomes as simple as with the modern pocket calculator (when it is enough to know which buttons to press and in what sequence), will computers begin to be widely introduced into the everyday work of the various types of specialists.

G. Aleksakov, docent, Moscow Engineering Physics Institute [MIFI], and scientific director, Student Research and Design Bureau (SIKB), Automatics and Telemechanics Department, put this problem before several students aspiring to the candidate of technical sciences. Under his direction, then-students V. Gavrilin, V. Fedorov, S. Gavrilyuk, A. Denisov, and others brilliantly coped with their tasks and created a desktop--not larger than a "diplomats" attache case--and exceptionally simple to operate machine, called an analog computer complex (AVK-4), or integrating calculator.



AVK-4 Analog Computer Complex

How is the AVK Constructed?

The main service of the creators of the AVK-4 is that they freed the computer user from the need to know its internal devices and programming languages. It is not even necessary to formulate an equation! This is the first analog computer system in our country programmed directly according to the block diagram of the process being studied. The type of process is unimportant: whether it is the heat exchange of the case of some kind of instrument with the surrounding medium or the respiration of plants, physical processes in electronic circuits or in motive systems, etc. It is sufficient, according to the system devised and the mnemonic representations visible on the front panel of the AVK-4, to connect the wires in the required sequence to the blocks that perform the mathematical operations specified, as if to compose the necessary picture (process flow) from the "blocks", and then to set by hand the values of the constant factors and initial conditions -- and the programming is done. Herein lies the principle difference between the integrating calculator created in MIFI from any other computer.

The block diagram (graphic representation of the interrelationships between variables characterizing the state of the object or process, and designation of the mathematical relationships between variables) is the natural language of the physicist or engineer. And the aspirants from MIFI made it a practical programming language, accessible to any specialist for communicating wih the analog computer. A person with the highest technical education can be taught in 30 minutes (in, let us say, FORTRAN an expenditure of not less than three months is required...).

But why did the developers decide to use an analog computer (the principle of operation of an analog machine is based on the identity of mathematical equations describing the various processes themselves: mechanical, optical, hydrodynamic, electrical...)? A digital computer makes it possible to obtain more precise results! However, the ordinary engineer in most cases when computing does not need umpteen digits after the decimal point. The analog machine has, in addition to the others, the important advantage in the visibility of the computational results -- any process under study can be seen right away on an ocilloscope. The digital machine "generates" columns or even "sheets" of digits that are incomparably more difficult to analyze. Of course, it is possible to "output" them in graphic form on a display. But this requires using additional, very expensive equipment and additional programs to output the data.

The AVK-4, in a single case, connects not only the original small analog computer, but also a series of indicating and measuring devices: a small cathode-ray tube on which one can observe four processes simultaneously, generator of various shaped signals, digital voltmeter, reference voltage oscillator. This is also the essential difference of the AVK-4 from other machines requiring external instrumentation.

The computational unit of the calculator consists of four plug-in design modules. The main one is type "I" (integrator). It performs three types of mathematical operations: amplification, addition, integration -- describing

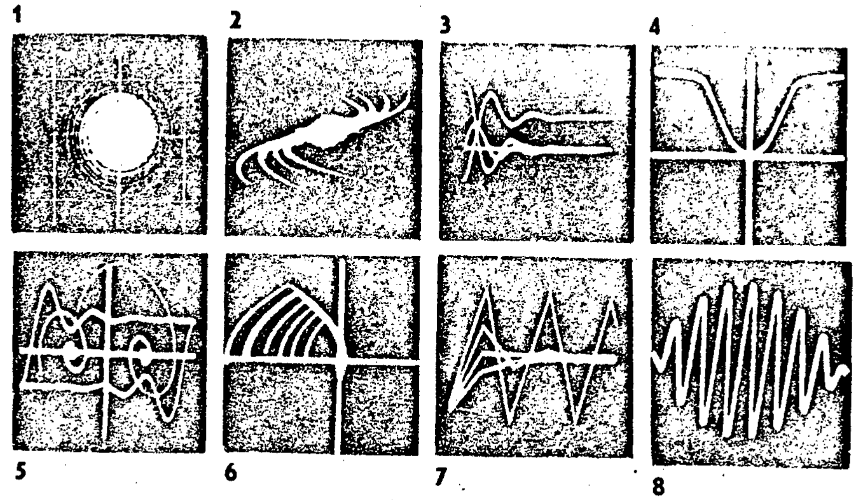


Illustration of the capabilities of the AVK-4 in various applications.

Key:

1. Solving differential equations (mathematics)
2. Studying processes in physical objects (physics)
3. Processes in electrical circuits and electronic systems (electrical engineering)
4. Feedback in converters (elements of automatic equipment and bases for drives)
5. Methods of theoretical studies and engineering design of control systems (automatic control theory)
6. Analysis of trajectory of movement (theory of optimal and experimental systems)
7. Stability and digital control algorithms (theory of pulsed systems)
8. Generation, modulation, detection, and spectral analysis of signals (radio engineering)

most of the functions (laws) between the physical characteristics of one process. Module "I", strictly speaking, models processes according to their block diagram and solves ordinary differential equations in all the standard ways they are written. The mnemonic displays on the panel of the unit, intelligible to everyone, show which jack to connect and which input to use to perform the necessary operation.

Another basic module is the "N" (non-linearity) module. It calculates non-linear functions of one variable (for example, volt-ampre characteristics) for modeling the statistical characteristics of objects.

An additional component includes module "U" (multiplier), which is needed for modeling non-linear functions of one or two variables and modeling statistical characteristics, and module "K" (quantizer), for modeling digital and pulsed control systems.

Using the adjustment knobs on each module it is possible to set the values of these or other coefficients and assign initial conditions. By turning these knobs the specialist will see, by the picture on the CRT, how the object conducts itself under various external factors. By changing the points of the connecting wires, assigning coefficients by hand, the researcher has the capability to model the most varied modes or, shall we say types of feedback, and to select the optimum at which the system being designed appears to be more stable in operation.

The module concept of construction of the AVK-4 makes it possible for the users to expand the array of plug-in modules by only those needed to solve a specific problem. For example, a "R" (reactor) module was built in MIFI: a six-group model of a nuclear reactor, used when modeling and designing control and protection systems for nuclear power installations.

The AVK-4 is powered from the 220 V, 50 Hz supply line, and it requires not more than 30 W. It weighs 8.5 kg. The machine is completely "idiot-proof", that is, from user error -- incorrectly connecting the terminals will not result in break-down of the instrument.

The AVK-4, in essence, is a modern slide rule for the engineer. The computer can be used everywhere there is a requirement to solve common differential equations to the fourth power, inclusively, and where it is necessary to study dynamic processes, that is, in practically all branches of science and technology.

Instruction: Keeping Abreast of the Times

The capabilities of this computer in the education sphere are impressive. This is what the prorector for education of MIFI, I. Gusev, professor, doctor of physical-mathematical sciences, said:

"An educational laboratory for the automatic control theory (TAU) course, equipped with AVK-4 computers, was created in the automatics and telemechanics department of our institute in 1979, with the active support of the education department of the institute. Even then we believed that the principles the developers incorporated in this computer would make it possible to stimulate in the students habits of a research character, aim them to a complete mastery of the problems in the automatic control of various dynamic processes, and would make it possible to better understand their physical essence. Seven years of practice confirmed the high effectiveness of using the AVK-4 in education...."

Currently, six higher institutes of learning in the country have laboratories equipped with the AVK-4: MIFI, STANKIN [Moscow Machine Tools Institute], Moscow Mining Institute, MEIS [Moscow Communications Electrical Engineering Institute], Kuybyshev Polytechnical Institute, Kharkov Aviation Institute. The laboratory in the Physics and Mathematics School No. 542, MIFI, has been in operation since 1984. Laboratory practicums based on the AVK-4 have been conducted on TAU and actual courses in automating production processes in

power engineering, controlling robots, flying vehicles, etc. Overall, there are now more than 25 courses using the AVK-4 in their studies.

The experience in the MIFI physics and mathematics school shows that this machine also can be successfully used for studying the physics being learned in the ninth and tenth grades.

In the seminar of schools of higher learning held last year, "Using the AVK-4 in the Educational Process", all of the speakers noted the high effectiveness of this minicomputer as compared with other series-produced computer equipment that could be used for the same goals. Addressing the AVK-4 in the "language" of a structural model and receiving a reply in graphic form, and what is more, in an experiment approximating the actual physical model, frees one from the need to first study computer equipment and the artificial language to program it, which makes it possible to focus the attention of the students on developing the experience of constructing a physics experiment.

This author was in Moscow school No. 542 where, for the first time in our country, the analog computer is being used in instructing students, and spoke with the head of the physics department of MIFI, docent A. Rudenko, and an instructor from the same department, L. Potat'yeva, candidate of physical and mathematical sciences -- the persons engaged in introducing the AVK-4 to school life.

Their opinion is: "The introduction of the computer to the educational process of the modern secondary school is a task set forth by the reform of secondary and professional education. Present-day children who are faced with living and working in the computer environment must be trained in it as early as possible (in Japan this is done from five to six years of age). Now, in a number of schools, the children are being familiarized with a display and taught the work of statements. However, the output power of the computer and its logic capabilities are not being used. The computer itself, as a rule, is out of sight of the students, separated from them by various consoles, data input-output devices, etc. Therefore, to the students the computer remains a "black box" with which only competent staff members of the computer center are capable of dealing. The AVK-4 is a completely accessible machine, not only in operation: they can touch it (which is extremely important for the youngsters!), turn it, play with it, and experiment with it. This feature psychologically trains the children to work with the computer, and it makes it possible to make theoretical school courses--primarily physics--clearer."

This is what the students themselves say: This thing is excellent, clear... When you do an experiment with your own hands you remember it for a long time... With the AVK you have to think... It was very easy and pleasant for me to work with it, even enjoyable...

Consider this: they got enjoyment from studying. Isn't this the everlasting dream of all students and their teachers?!

The economic calculations were cited in the report on the introduction of the AVK-4: a comparison between a class using the AVK-4, and a class with

displays operating with a digital computer. The educational effect over the cycle of the TAU discipline was the same. But the economic effect from using the integrating calculator for only the first year was 150,000 rubles, because the display equipment was much more expensive. And this did not take into account the software for the display class (without which this expensive equipment is simply a pile of metal!). For the AVK, as we know, software is not required.

Why Don't They Give It a Medal?

It says in the Basic Directions of Economic and Social Growth of the USSR from 1986 to 1990 and to the Year 2000: "Organize the mass production of personal computers. Provide a 2- to 2.3-fold increase in the amount of computer equipment production, and increase its reliability. Increase the scale of use of modern high-performance computers of all classes at a high rate... More actively introduce informatics and computer equipment into the educational process." The majority of these important tasks can be performed by using the integrating calculators created at MIFI.

And the developers were most deservedly recognized with various awards. For example, the AVK-4 won the VDNKh [USSR Exposition of National Economy Achievements] medal in 1978, 1980, and 1982. It was successfully exhibited at expositions in England, the German Democratic Republic, Italy, Czechoslovakia, Bulgaria,.... The interdepartmental commission of the USSR Minvuz [Ministry of Higher and Secondary Specialized Education] awarded the development the highest class of quality. The State Committee for Inventions and Discoveries granted production prototype certificate No. 15272 to the authors of the calculator. The Sixth All-Union Conference on AVM [analog computers] and ATsVM [hybrid computers] noted the AVK-4 among the achievements of domestic science and technology for the 10th Five-Year Plan and recommended beginning its series production. The USSR State Committee on Science and Technology officially proposed to include the computer in the plan for assimilating new technology for 1983.

Alas! To date only several tens of machines have been produced. The MIFI experimental production plant "Kvant" and the Akhtyrskiy plant "Promsvyaz" have manufactured small lots of them.

G. Aleksakov showed me two thick cases (!) of requests for the AVK-4 that had arrived at the institute.

There were even requests from abroad. According to data of the USSR Minvuz, the demand for such calculators by institutes of higher learning of our country is 5,000 units a year. They are needed in various academic and branch research institutes, design organizations, and, of course, in secondary schools. It is necessary for the industry to put these machines in series production. However, until now an interested department has not been found. The USSR Minpromsvyaz [Ministry of the Communications Equipment Industry], Minpribor [Ministry of Instrument Making, Automation Equipment, and Control Systems], and Minradioprom [Ministry of the Radio Industry] have not decided who will take on production of the AVK-4.

Today, our industry does not have the right to disregard such promising developments made by scientists of the institutions of higher learning. This indifference is costing our country dearly: in fact, the insufficiently effective education of students on antiquated equipment undoubtedly will result in the level of yesterday's specialists.

It is an amazing affair: the AVK-4, having received so many prestigious awards, is not being hurried to the production line. Besides being simpler, this machine is reliable and inexpensive, and it does not have any expensive parts or parts that are in short supply.

While bureaucratic games are being played in the ministries, the developers of the integrating calculator have long since become engineers and are occupied with other matters. But in the MIFI SKIB a more modern machine has been created: the AVK-6. It has six plug-in design modules. This makes it possible on one calculator to follow a linear system to the sixth power, inclusive (when studying non-linear systems the maximum order is reduced to the number of non-linearities being studied). It has the capability for joint operation of two or three calculators; in the latter case it is feasible to study a linear system to the 18th power!

The AVK-6 has already been recognized by gold medals from the VDNKh and at the 1985 autumn Leipzig [Trade] Fair. In Leipzig, American, French, and Yugoslavian specialists coming to the stand were interested in this computer.

Years pass, the names of the exhibitions change, only the fate of the "gold" exhibits, as usual, remains very problematic. That is why G. Aleksakov looked unhappy while showing me the many medals and diplomas. He does not need laurels, nor do the other "thinkers", but the knowledge that their work will be of appreciable use to many people. When will this happen? Who will respond?

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MAXIMUM SPEED OF RING DATA EXCHANGE DEVICES FOR PARALLEL COMPUTER SYSTEMS

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 10, Oct 86 (manuscript received 20 Sep 85) pp 151-156

[Article by S.I. Uvarov and M.A. Chernyshov, Moscow, Kharkov]

[Abstract] Parallel computer systems, particularly multiprocessor systems, make broad usage of ring data exchange structures for information interchange among processor elements. This article estimates the maximum speed of such a device, in which requested data are transferred from processor element memory to communications channel memory and other processor elements are informed that the information is available, after which they transfer the information from communications channel memory to their own memory. The possibility of practical implementation of structures achieving the maximum theoretical speeds is demonstrated. Figures 2, references 6: 5 Russian, 1 Western.

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CSO: 1863/187

COMPUTER APPLICATION OF STATE-PRIZE WORK ON MOLECULAR SPECTROSCOPY

Tallinn SOVETSKAYA ESTONIYA in Russian 21 Jan 87 p 3

[Article by N. Grigoryeva, correspondent, Tartu]

[Text] If it were said that two complete sets of the Large Soviet Encyclopedia could be recorded in an area of one square centimeter, most people would probably laugh at such a claim. But scientists of the Estonian Academy of Sciences' Institute of Physics have achieved precisely such information-recording density with the aid of laser spectroscopy.

An original method developed by R. Avermaa, A. Gorokhovskiy, Ya. Kikas and L. Rebane, laureates of the 1986 USSR State Prize, has made it possible to raise the precision of spectral measurements by 10,000 to 100,000 times, and thus to investigate phenomena on the molecular level which were hitherto unknown. At the temperature of liquid helium, very fine lines were found to appear in the spectra of certain materials, such as polystyrene with special impurities in it. The absence or presence of such lines can serve as a binary code.

A laser beam is used as the 'optical scissors' which cut these lines out of a spectrum. When directed at a polystyrene film, the beam burns out, at the point of incidence, impurity molecules which absorb light of this frequency. A gap appears in the spectrum--in other words, a 'hole' in a kind of optical perforated tape. If the laser's frequency is changed, other molecules are burned out, the next hole appears, and so on. The frequency of the radiation can be changed up to a thousand times at a single point in space. Information usually is 'aligned' horizontally and vertically in space during recording. Still another coordinate, a spectral one, is made possible by the new method of recording.

In the near future, the optical perforated tape will find use in computers that operate with huge arrays of information, and also in global data banks. Information about everything on the earth's surface the size of a tree or larger can be recorded accurately on a single square meter of such film.

FTD/SNAP
/13046
CSO: 1863/178

PRIZE RECIPIENT FOR WORK ON MOLECULAR SPECTROSCOPY

Moscow LENINSKOYE ZNAMYA in Russian 29 Nov 86 p 2

[Unattributed article]

[Text] A group of Soviet physicists has been awarded the USSR State Prize in science and technology for the work-cycle "Photo Burning-Out of Stable Spectral Gaps and Selective Spectroscopy of Complex Molecules." The authors of this cycle were the first to develop methods for ascertaining the fine structure of certain spectra. Methods which they developed and results of their research have created a new direction in molecular spectroscopy and solid-state physics, and are now finding various practical applications as well.

(The photograph shows Doctor of Physical-Mathematical Sciences, Professor R.I. Personov, head of the department of molecular spectroscopy of the USSR Academy of Sciences' Institute of Spectroscopy and one of the cycle's authors. Personov has published 110 scientific works.)

FTD/SNAP
/13046
CSO: 1863/178

PRIZE RECIPIENT FOR WORK ON MOLECULAR SPECTROSCOPY

Moscow LENINSKOYE ZNAMYA in Russian 21 Dec 86 p 4

[Unattributed article]

[Text] A work-cycle which was awarded the USSR State Prize in 1986 bears a rather complicated title: "Photo Burning-Out of Stable Spectral Gaps and Selective Spectroscopy of Complex Molecules." Let us explain that this work has created a new direction in molecular spectroscopy and solid-state physics, and it is a worthy contribution to both purely theoretical sciences and applied research.

A large group of authors, including associates of the USSR Academy of Sciences' Institute of Spectroscopy in the city of Troitsk, were named recipients of this prize.

(The photograph shows Candidate of Physical-Mathematical Sciences Ye.I. Alshits, associate of the institute's electron-spectra laboratory and one of the award recipients.)

FTD/SNAP
/13046
CSO: 1863/178

RECIPIENT OF STATE PRIZE FOR SELECTIVE SPECTROSCOPY

Tallinn SOVETSKAYA ESTONIYA in Russian 9 Dec 86 p 1

[Unattributed article]

[Text] Research center in the city of Troitsk, Moscow Oblast--A group of Soviet physicists has been awarded the USSR State Prize in science and technology for a work-cycle entitled "Photo Burning-Out of Stable Spectral Gaps and Selective Spectroscopy of Complex Molecules." The authors of this cycle were the first to develop methods for ascertaining the fine structure of certain spectra. Methods which they developed and their research led to a new direction in molecular spectroscopy and solid-state physics, and now a variety of practical applications are resulting as well.

(The photograph shows Candidate of Physical-Mathematical Sciences B.M. Kharlamov, senior science associate of the electron-spectra laboratory of the USSR Academy of Sciences' Institute of Spectroscopy, who has authored 30 scientific works which have been published in the USSR and abroad.)

FTD/SNAP
/13046
CSO: 1863/178

SODALITE GLASS WITH ERASABLE MEMORY STORES OPTICAL INFORMATION

Moscow IZVESTIYA in Russian 5 Jan 87 p 3

[Unattributed article]

[Text] Tartu, Estonian SSR--A sodalite-crystal glass developed by Estonian scientists has the enviable property of memory. It will find extensive use in science and technology, in the economy, and in the household.

A laser, x-ray or electron beam leaves a dependable imprint on the glass. Inscriptions or drawings are clearly visible with any form of lighting, they can be multicolored, and they can be erased innumerable times by simply heating the material to 300 degrees. But this glass can preserve the recorded information for many years.

The innovation, which was developed by scientists of the Estonian Academy of Sciences' Institute of Physics in collaboration with specialists of the State Optics Institute imeni Vavilov, can, for example, be used to record information from space.

FTD/SNAP
/13046
CSO: 1863/178

UDC 621.382.8:681.324

DESIGN AUTOMATION OF LSI CIRCUITS IN MULTIPROCESSOR COMPUTER SYSTEM WITH COMMON FLOW OF INSTRUCTIONS

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 7, Jul 86 (manuscript received 6 May 85) pp 125-132

[Article by M.S. Sonin and V.V. Shvedenko, Moscow]

[Abstract] The authors have developed a program for parallel analysis of nonlinear circuits, allowing computation of transient processes in digital and analog electronic devices. The nonlinear circuit analysis program is intended for modeling of electronic circuits containing large numbers of nonlinear elements such as diodes and transistors. The method of nodal potentials is used to form equations for the system of connections of nonlinear elements, while each nonlinear element is considered a black box, the internal structure of which can be unambiguously defined by the voltages on the conduction paths and its previous state. The circuits modeled are thus represented as sets of nonlinear elements interconnected directly or through linear elements such as resistors, capacitors and current sources. The program runs on a PS-2000 computer system and is intended for design of parallel-processing LSI devices. Figures 2; references 8: 6 Russian, 2 Western.

6508/13046
CSO: 2863/178

FRG FIRM TO PROVIDE SOFTWARE SYSTEM SCIENTEX TO SOVIETS

Stuttgart DIE COMPUTER ZEITUNG in German 16 Jun 86 p 6

[Article: "Agreement with Academy of Sciences About To Be Concluded: Software for the Soviet Union"]

[Text] Munich (ZI)--A small German software development firm has attempted to meet the powerful American software giants head on--with success. The Midas company has discovered an untapped market. The result: It is supplying software to the Soviet Union. The program, called "ScienTex," has already been translated into Russian. Conclusion of the cooperative agreement is currently being delayed week after week, however, even though the Soviets themselves have said that they have already begun series production of an IBM-compatible PC.

ScienTex is just one of many text processing programs, and yet it is unique. According to Midas, it is the first program which has been translated into Russian and also the first which the Russians want to buy. Beginning in August, the IARS and Multigraf programs are also to be officially offered for sale in the Soviet Union, said Wolfgang Fechner, a Midas employee, at a press conference in Munich. Business with this East Bloc nation would greatly increase Midas' sales, he said, although its scope remained a company secret. The Academy of Sciences committee in Moscow has also not yet signed the agreement even though it was planned weeks ago. Not only in Germany do bureaucracies result in delays.

Midas has only been in existence for three years. Its area of expertise is software development in the scientific and technical fields. In 1985 it had sales of DM 4.2 million. More important than numbers, however, is the fact that the ScienTex text processing program was selected as the 1985 software program of the year. But this alone cannot have been the deciding factor in terms of the deal with the Soviet Union. In addition to the good relations Midas has with Moscow, the presence of the Cyrillic alphabet in ScienTex was probably of greater importance to the Soviet scientists. Moreover, ScienTex can do so much more.

It has all of the usual text processing functions such as copy, delete, block move, boldface, block justification and so on. However, by pressing a key the user can also switch to the Cyrillic or Greek alphabets or to mathematical and

chemical symbols. A total of five character sets are available. In addition, a character set editor allows the user to generate his own characters.

ScienTex runs on all IBM PC's and compatibles and requires 256K RAM. Printers made by Epson, NEC and others can be added, as well as any other printer so long as it has the so-called "character download" feature. The LARS (powerful archiving and research system) data bank, according to Midas, is the fastest information data bank available for a PC. The advantage offered by the program is that LARS finds the key word sought regardless of its subject area classification. And it does it fast--5000 documents or files can be searched within a few seconds. Its disk capacity, at 10 Mbytes, is about 30,000 titles. The new expanded LARS program allows greater flexibility by means of 32 freely definable data banks. Multiple indexing of 40 different data fields is possible, with up to 65,000 documents per data bank. LARS is able to search with variously interlaced "and," "or," and "without" operations, thus facilitating the search. Interval, word root and date queries are also possible. LARS runs on all IBM PC's and compatibles.

Large-scale computers which have up to now handled remote data transmission operations for businesses simply cost much too much and moreover are subjected to very high usage. Therefore, an existing PC with modem can be converted to a data concentrator. The "Data-Express" program allows two computers to exchange data with one another inexpensively and even without the need for an operator.

Data-Express is controlled via function keys and permits both manual and completely automatic transmission. In the manual operating mode telephone numbers can be dialed and data sent or recalled. In the automatic mode a list of telephone numbers is dialed at any desired time of the day without the need for an operator. Midas' Data-Express runs on all IBM PC's and compatibles.

Currently in preparation at Midas is a combination of the LARS data bank and the Data-Express program. As is usually the case with such advance announcements, no information was available on when this product might be available. Others in the field will certainly not be disconsolate about that.

12552
CSO: 3698/240

UDC 681.142

RECURRENT MODEL OF MULTILEVEL AUTOMATED EXPERIMENTAL RESEARCH SYSTEMS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 289, No 4, 1986 (manuscript received 16 May 85) pp 806-808

[Article by V.V. Belosh, M.B. Ignatev, S.L. Lidin and V.A. Putilov, Siberian Institute of Terrestrial Magnetism, The Ionosphere and Radio Wave Propagation, Siberian Division, USSR Academy of Sciences, Irkutsk; Leningrad Institute of Aviation Instrument Building]

[Abstract] Recurrent automated scientific research models provide a formal apparatus for the development of such systems, planning and implementation of complex studies optimal in some predetermined sense. An abstract model of an automated experiment is constructed by abstracting from the specific content of its component object areas and their replacement with the concept of classes of equivalency of tasks. In each class a new equivalency relationship is assigned, relating tasks to various sublevels and dividing each class of equivalency into subclasses until the level of primitives is reached, subtasks which cannot be further divided by the investigator. The construction of an automated experimental research system is then performed from the bottom up, in the direction opposite to the top down decomposition of the subject area, which is now complete. LEADER (language for experiment algorithm derivation) has a simple, rigid structure common for all levels of decomposition and is recommended for composition of experimental algorithms from the top down by successive increases in level of detail. The LEADER system includes a common data base of concepts generally accepted in a given problem area to avoid the need to redefine these concepts for each experiment. References 3: Russian.

6508/13046
CSO: 1863/37

UDC 519.682+510.6

MATHEMATICAL PRINCIPLES OF SEMANTIC PROGRAMMING

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 289, No 6, 1986 (manuscript received 22 Aug 85) pp 1324-1328

[Article by S.S. Goncharov and D.I. Sviridenko, Institute of Mathematics, Siberian Division, USSR Academy of Sciences, Novosibirsk]

[Abstract] A logical programming language must be looked upon as a language allowing easy manipulation of descriptions convenient for man. The language of formal logic is natural as a mathematical model of such a language. Within this language, fragments must be found which are expressive and allow effective algorithmic implementation. It is suggested that the language of so-called Σ-formulas of multiple-type first order calculus with lists be used as such a fragment for semantic programming. The availability of lists as a new type of object significantly increases the expressive force of the language. The logical programming language PROLOG represents a serious step in the creation of adequate means for solution of logic problems. Limitations and problems of PROLOG are noted. The authors call for the construction and development of a general theory of computation based on logical principles such as the theory of permissible sets. The concepts of semantic programming are outlined. It is concluded that GES theory provides the only effectively presentable list superstructure guaranteeing semantic correctness of Σ-programs. References 9: 5 Russian, 4 Western.

6508/13046
CSO: 1863/37

UDC 681.324

INTERACTION OF PARALLEL PROCESSES IN THE OPERATING SYSTEM OF THE PS-3000

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 6, Jun 86 (manuscript received 7 Feb 85) pp 166-169

[Article by A.Z. Ioshpa, P.G. Miroshnichenko, V.M. Rabinovich, E.A. Trakhtengerts, Ye.V. Sherbakov and V.S. Yavnilovich, Moscow, Severodonetsk]

[Abstract] The interaction of parallel processes in the operating system of the PS-3000 multiprocessor computer is examined. There are two possible approaches to interaction of parallel processes in such a computer: A redundant set of interacting facilities can be created, considering that each facility will work well in some cases and poorly in others; or a universal, nonredundant set of interacting facilities satisfying all types of parallelism can be generated. The authors of the PS-3000 operating system consciously selected the second method of implementing interactions, assuming that the slight decrease in reaction speed of synchronization mechanisms would be more than compensated by the superior ease of use and reliability of functioning of

the operating system achieved by identical organization of the interaction of parallel processes regardless of the type of parallelism involved. The operation of the PASS, POST and WAIT subroutines which support the interaction of parallel processes is described. References 1: Russian.

6508/13046
CSO: 1863/176A

UDC 681.3.016

FRAGMENTATION OF RELATIONAL EXPRESSION IN PROCESSING REQUESTS IN RELATIONAL DATA BASE MANAGEMENT SYSTEMS

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 7, Jul 86 (manuscript received 4 Jun 85) pp 133-143

[Article by M.Yu. Khodzhayants, Moscow]

[Abstract] A new approach is suggested to the creation of query processing algorithms based on the formalized concept of the "index," including a broad class of indexing methods. The approach allows construction of standardized query processing algorithms for data base management systems in which indexing methods are permitted satisfying the indexing definition given. The major idea of the approach suggested is as follows: Suppose that relations are stored in the data base as tables, certain attributes or groups of attributes of the tables being indexed. Each index induces a certain subdivision of the corresponding table into horizontal fragments. The fragments can be defined by either logical or physical factors (contents or memory page location). In either case, a query, a set of operations in relational algebra over the relation, can be converted to a sequence of queries to operate on the fragments rather than the entire relation. The approach suggested allows queries to be processed by accessing stored relations only in the last stage of processing, earlier stages manipulating only the indexes. References 4: Russian.

6508/13046
CSO: 1863/178

UDC 658.512.2.011.56:64-504

PRINCIPLES OF CREATION OF THE COLLEGIATE 'AKADEMSINTEZ' LOGICAL PLANNING APPLICATION SOFTWARE SET

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 7, Jul 86 (manuscript received 21 May 85) pp 144-151

[Article by V.P. Chistov, Sverdlovsk]

[Abstract] Specialized programming systems have been used to create unique task-oriented CAD systems. The approach used within the AKADEMSINTEZ project is based, in contrast, on combining the efforts of designers to create

information-compatible CAD facilities suitable for the generation of specialized systems. This article discusses the organization of information exchange in the logical stage of automatic design of discrete computer and control systems. The software discussed includes six subsystems: planning, modeling, simulation, documentation, compilation and composition, or construction of model descriptions from library forms. The structure of the software and its utilization are described. The discussions presented in this article provide only a general concept of the principles required to support communicability among designers of individual subsystems. The complete rules have been published as canons, canonizing the concepts used, form of representation of functional and structural descriptions of elements, declaration of the data base of tools, rules for formation of modules and presentation of their descriptions and information on organization of the standard versions of software sets. Figures 2; references 3: Russian.

6508/13046
CSO: 1863/178

UDC 681.3.06:681.326.7

USE OF INFORMATION REDUNDANCY TO RESTORE PROGRAMS

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 7, Jul 86 (manuscript received 9 Apr 85) pp 152-162

[Article by I.V. Shagayev, Moscow]

[Abstract] Methods are discussed for introduction of information redundancy to structured programs, allowing the cost in processor time and memory requirements for restoration of the computer process to be decreased. Restoration refers to restarting the process after a hardware error has caused an interruption. The article analyses methods of restoration of programs without considering the type of process which the program implements by restoring the status of peripheral devices and eliminating intermediate records written by the program, assuming that a fault-tolerant computer is operating in single-program mode. Figures 5; references 11: 1 Russian, 10 Western.

6508/13046
CSO: 1863/178

UDC 550:683.06

THE PRINCIPLES OF ORGANIZING A PROGRAMMING SYSTEM FOR GEOLOGICAL AND GEOPHYSICAL PROBLEMS (USING THE "MR" SYSTEM AS AN EXAMPLE)

Alma-Ata VESTNIK AKADEMII NAUK KAZAKHSTOY SSR in Russian No 11, Nov 86 pp 22-25

[Article by A. A. Ibrayev and Ye. N. Nusipov]

[Abstract] The earth and its interior are the subject of geological research. The structure of the Earth's core -- the basic subject of applied geological research -- is quite diverse, and to two of the Earth's geological structures are alike in all aspects. Geological processes occur over extremely long timespans, and, as yet, scientists are unable to replicate and observe them from beginning to end.

Objectively observed interrelationships among structural elements are used to construct a preliminary model of part of a structure, and changes are made in the model when new information is obtained. However, since information can be obliterated or distorted by subsequent geological processes, different conclusions can be reached on the basis of the very same data. In order to obtain objective conclusions, it is necessary to use computer-aided mathematical methods.

At first, computers in geology were restricted to a narrow range of problems. Programs were designed to solve specific problems and were unrelated to one another. The data for a particular program was formatted according to its own rules and was entered into a computer solely for the purpose of solving that particular problem. Computers were used as high-speed number crunchers.

The development of computer technology and systems analysis demanded a reexamination of how software is developed. Automated processing systems and data banks appeared which operated on standardized data arrays stored on magnetic storage devices. However, the control data for the programs was usually not standardized, program flow charts were not documented, and each program executed only part of the work required. To start up another program, control data had to be input. If one were to draw an analogy between computers and calculators, then one could say that computers are being used as calculators with memory registers for numbers.

However, computers differ from all types of calculators in that, in addition

to the data being processed, they store programs, i. e. a sequence of statements, each of which consists of a control instruction and operands. When a sequential statement is processed, its instruction is read into an arithmetic-logic unit, and the operands are referred to in order to find the addresses of the data to be loaded into the registers [1]. Upon completion of the loading cycle, the instruction is performed using the data contained in the registers, and the result is written onto the appropriate memory address. Control is then transfered to the next statement or, if the statement execution sequence is changed, to a statement, the address of which is defined in the operation.

If one were to standardize the control data for programs used by conventional data-processing systems, separate the operation (instruction) and operands contained within a statement, and, in addition, store the sequence of these "statements" on the very same devices that contain the data arrays being processed and in the formats used by the data exchange modules of a particular system, then one would have a working model of a computer wherein the "working memory" is the system's data base, the "arithmetic-logic unit" along with its register is the central processing unit in the computer, and the "input-output devices" are the modules for exchanging information with either the computer's integral components or with the formats of other interfacing systems. Entering a procedure consisting of these types of statements into a data base permits control instructions such as "transfer control" or "address the procedure". The system of instructions performed by the "arithmetic-logic unit" would be fully defined in terms of the requirements of the problem being solved. This type of data-processing system can already be called a programming system, inasmuch as it will provide for all of the necessary programming components.

The MR system, which was designed and is undergoing further development at the department of mining geophysics at the Kazakh Polytechnical Institute imeni V. I. Lenin, was at first meant to automate the process of measuring the influence of a magnetic relief. This is not a new problem, but it is still awaiting a sufficiently complete solution because of a number of factors, the most important of which are: a) the vectorial nature and extreme variability of the magnetic properties of rock; b) the influence of the magnetic masses that form the uneven topographical surface of a relief; c) the indefiniteness of the coordinates of the observation points in airborne magnetic surveying done in mountainous terrain. This problem is solved by using statistical or determinant methods alone or in combination, with, depending on the topogeological situation, preference given to those methods that yield an applicable solution at the lowest possible cost.

The specialized data controllers of the MR system process standardized arrays of data in the "Matritsa [Matrix]", "KhT" (characteristic points), "Kontury [Contours]", and "Protsedura [Procedure]" formats. The KhT and Contour formats are designed for storing cartographical data (charts of isolines, geological contours, model sections, and so forth), the Matrix format for basic calculations and exchanges with interfacing systems, and the Procecure format for remembering the sequence of the control statements.

The system of control statements consists of a limited number of instructions which comprise: MRPROC -- the statement for naming a procedure; MRCALL -- the statement for addressing a previously formulated procedure; MREND -- the statement for ending a procedure; MRSTOP -- the statement for terminating calculations; MRGT -- the statement for transfering control; MRFUN the statement for performing a function, i.e. the sequence of statements, which, in contrast to the procedures, are written in FORTRAN, and assignment and variable description statements as well. The variables processed by the system of control statements can be any of the following: label, function, simple variable, structure, or array (Matrix, KhT, or Contours formats).

The language of the MR system is a high-level language based on the formats of FORTRAN, which is the most widely used algorithmic language in the world [2].

As in FORTRAN, the statement being executed can be labelled, but the label must be alphanumeric. During form encoding, the label is written in the first five positions, the sixth position is read as the position for the continuation key (if it contains a symbol other than a space, then the card is read as if it were a continuation of a previous card), and the statement is written in positions seven to 72. If an asterisk is written in the first position of the card, then the card is read as a card-commentary. The instruction for addressing a built-in function is written in the form of the name of the function with the operands supplied in parentheses.

The first stage of an MR system comprises the following functions:
1) the input-output of data in the integral devices, and data exchange with other systems;
2) printing, editing, and visual dumping (the visible transfer of graphic information to the ADC (analogue-to-digital converter) controller);
3) computation of algebraic and transcendental functions and statistics;
4) solving the direct problem of gravitational-magnetic surveying from the contact relief surface and self-contained models.

In order to process data with the MR system, the user must learn how to prepare materials for three programs: MR/SPECS, (initial preparation of the system for operation and specifications maintenance), MR/FORTS (statements compilation), and MR/PROCS (working with procedures).

Most of the functions in the first stage of the MR system are listed in another publication [3]. To this list have been added the mathematical functions of the FORTRAN unified computer systems [1], and the list now contains over 100 functions.

Here is an example of how the MR system works. An isomagnetic chart needs to be input into the computer's memory and the data used to build a matrix. The chart was encoded on a "Shifrator-2 [Encoder-2]" device, and the punched tape thus generated was input and recorded on magnetic tape in the form of a file entitled "Encoder Punched Tape".[4].

The procedure for obtaining a matrix in the language of the MR system is written as follows:

```
MRPROC (EXAMPLE)
MRDIM (XI, MT)
JMSH (50,000)
XTFR (XI)
JMTR (12,14, 500, 600, 6500, 0, 6500, 5500)
JOKVXT (8, 100, 2000)
XTML (XI, MT)
MREND
```

The MRPROC statement gave the name EXAMPLE to the procedure, the MRDIM statement described the data arrays XI and MT, and the JMSH statement defined the visual dumping scale (here equal to 1:50,000). The XTFR statement converted the data from the "Encoder Punched Tape" file into the XT format, which was called XI. The JMTR operator defined the parameters of the matrix being interpolated in the following order: number of columns and lines, line-by-line intervals and intervals between lines, and the end coordinates of the first line. The JOKVXT statement defined the parameters of the sliding window used for the Lomtadze method of interpolation [5]: number of sectors, radius of the epsilon region, and the window radius. The XTML statement was used to perform the interpolation from the characteristic points to the matrix loci.

This example demonstrates the flexibility (ensuring the greatest possible number of functions in each situation), reliability (data is accessible to the user at any moment), clarity, and simplicity of operation of the MR system. These are indispensable attributes for cybernetic systems.

The MR system is not a transient phenomenon, but a system that is developing in accordance with practical requirements. Of course, it can keep up with the appearance of new data formats and different functions, and, in the opinion of the authors, all automated systems should be patterned after it.

The use of computers in geology is being held up by the insufficient formalization of geological methods of data processing. The geological disciplines closely associated with the precise natural sciences (geophysics, geochemistry, and so forth) are the most formalized. For now, computers are used to solve partial problems. However, after decision-making processes are formalized, the MR system will be able to be used for discriminating among competing hypotheses, the processing of one of which will signify the processing of a procedure especially formulated for it. Making the final decision will involve the processing of the MRGT statement for transfering control in a predetermined manner. In other words, the MR system will be utilized as an adaptable cybernetic system [6] for solving concrete geological problems.

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13050
CSO: 1863/172

INTEGRATED ASU INTRODUCED

Minsk NARODNOYE KHOZYAYSTVO BELORUSSII in Russian No 11, Nov 86 pp 22-23

[Article by L. Golubeva, Candidate of Philosophical Sciences, and B. Sobolev, Candidate of Technical Sciences; first paragraph is introduction]

[Text] Automated control systems have won a firm position in manufacturing. Every enterprise has available one or another type of these systems and, moreover, the number of these types is increasing. Plant technology management automation systems (ASUTP), computer-aided design systems (SAPR), automated quality control systems (ASUK), plant management automation systems (ASUP), flexible manufacturing systems (GPS) and others are being developed. This is a regular process. Automation of labor-intensive routine operations permits man to be involved more in genuinely creative work and to find and utilize necessary information on a current basis. The saving due to introduction of plant management auto- mation systems during the past 5-year plan comprised more than 25 million rubles alone at Minselkhozmash [USSR Ministry of Tractor and Agricultural Machine Building] and the saving was achieved by reducing product cost.

However, what satisfied us yesterday now appears to be rather modest. Manufacturing can achieve a greater saving if integrated automated management systems (IASU) are developed and introduced. These systems consist of ASU of different manufacturing management levels, beginning from the director and ending with the team, and also include automated systems of various types (SAPR and plant technology management automation systems), which support production and design preparation of manufacturing. The need for integrated systems was felt especially acutely 5-6 years ago, primarily at those enterprises which were the leaders in scientific and technical progress. Development of an integrated ASU was begun in 1982 at the Production Association Minsk Tractor Plant imeni V. I. Lenin, jointly with the main developer of all previous units of the ASU--the Central Scientific Research and Production Design Institute of Management Organization and Technology (TsNIITU).

Several units of ASU functioned successfully in the association by this time. These are the ASU-MTZ, one of the country's first real-time plant management systems, ASU-MZSIiTO, introduced in 1979 at the Minsk Special Tools and Production Fittings Plant, included in the association, the ASU-MTPO association

management automation system based on the YeS-1022 computer, which made it possible to solve a considerably greater number of tasks.

One could seemingly stop at this point. But each new unit of ASU has revealed reserves for plant management and this induced the developers toward further improvement of the system. The new ideas have gained support among the collective of tractor builders and its managers.

And it was always this way at the Minsk Tractor Plant. For example, the first unit of ASU, which not only computed wages, as was done at a number of enterprises, "was put into operation" in 1969. The cooperation of scientists and manufacturers made it possible to determine deeper capabilities of the computer in plant management and namely: its capability of retaining data in "memory" about the course of production and to process it considerably better than is done by planners.

The questions "Why is an ASU necessary?", typical for the first phase of development of ASU, never arose at the Minsk Tractor Plant. It is no secret that some managers talk as follows: "Give us the materials and equipment, support us with people and we will make a plan without ASU!" But they forgot about the extremely long idle times of equipment and losses of work time due to nondelivery of raw materials and parts. The usual matter for the foreman was to check "on the run" the support of workstations and then to adopt measures for normal work. He telephones for some services and others telephone for other services. Still others are unaware. And they are unaware at the warehouse: they are unable to keep a record of materials. The cause of this situation is the slow exchange of information and untimely processing of it. Only a computer can help to resolve the problem, although at that time its capabilities were modest as information hardware.

Conscious rejection of the established stereotypes of thinking contributed to successful introduction of ASU. Moreover, the Minsk Tractor Plant avoided the unmistakable attraction of the prestige of a computer. Among those managers who correctly evaluated the capabilities of computer hardware was Ivan Ivanovich Demchenko. Still working as shop chief, he participated actively in implementation of ideas on automation. And I. I. Demchenko did a lot in the post of chief engineer of the association to see that the ASU become an inseparable part of the plant and introduced fundamental changes in the management sphere. The group of ASU would have been impossible if much attention had not been devoted at the Minsk Tractor Plant to the interrelationship of operation of all shops and auxiliary subdivisions. It is no secret that only the assembly shop is visible at many enterprises and, moreover, the indicators are calculated for it. Parts or assemblies are available in other subdivisions or breakdowns in intershop delivery occur. It is very difficult to subject poorly connected systems to management automation.

The growth of ASU at the Minsk Tractor Plant occurred due to all the basic shops and auxiliary subdivisions (repair and warehouse facilities) encompassing automation. Moreover, very many organizational measures seem to anticipate the appearance of new units of ASU. As an example, one can name the conversion of

the enterprise to the unified design documentation system (YeSKD), the unified production documentation system (YeSTD) and the All-Union unified industrial product classifier. All this ensured the readiness of the association for development and introduction of an integrated ASU. The plant needed this progressive integrated system, since the number of modifications of tractors increased every year and there was a need to convert to an adjustable technology.

By this time, the head enterprise had available a large computer center. Its machine stock consisted of YeS computers with total memory capacity of 11 million bits, with a developed peripherals system. However, there was essentially no experience in developing these ASU and the developers had to largely review their own practice.

In fact, those units of ASU which had already been introduced were designed on the following principle: each subsequent unit was built up by addition of new tasks subject to automation. It would seem that the efficiency of the ASU should increase in geometric progression because of this, but in practice there was arithmetic progression instead of geometric progression. It is no accident that the opinion about the inefficiency of ASU was established at a specific phase. The main reason for this lack of agreement was the design principles of ASU.

For what did the enterprises work out these principles? The developers asked themselves this question and saw that they were designed for some average type of enterprise without a set of modifications of products and without a developed structure and infrastructure and, moreover, with orientation toward second-generation computers. And by this time the next generation computers had appeared.

The Minsk Tractor Plant was the flagship of the sector and had long ago passed the bounds of this average type and the concept of integrated ASU could correspond to it, which, as already indicated, takes into account the relationship of all spheres and functions of the production association. At the same time, the characteristic feature of the integrated ASU is that it is developed by using already available ASU based on previous generations of computers. Therefore, the problem of information compatability, and not only that problem, became especially acute. Tasks lying on the periphery of plant management were frequently automated in the "old" ASU.

Much that had been done previously had to be reconsidered from these positions: all the functional tasks had to be analyzed for the subject of their feasibility and redeveloped under conditions of an integrated ASU.

But improvement of the old is still not an integrated ASU. It includes such components as computer-aided design systems and plant technology management automation systems, which considerably changes the nature of management automation.

Let us consider this on the example of computer-aided design systems. At first glance, computer-aided design systems are only a means for automation of routine operations in design. It permits the designer to find acceptable versions, to review analogues, to make elementary computations and so on. And the question arises: what relationship does it have to the integrated ASU? It turns out it has a very direct relationship. After all, any integrated ASU is unable to do without a technical and economic data bank (specifications and technology, labor intensiveness, price, materials and so). At the same time, the computer-aided design system for technological preparation of production (SAPR-TPP) accumulates a large volume of information. Data are now simply written to machine carriers and rather complicated procedures exist for making changes in the data bank. To avoid "transport" of this information from department to department and to avoid using time for reworking it, it is sufficient for the computer-aided design system to be included in the integrated ASU, i.e., to supplement the bank in the automatic mode.

Taking the scale of tasks into account, which the developers of the integrated ASU and tractor plant managers face, a new form of predesign examination and development of the technical assignment was adopted. According to the joint order of the general director of the association and of the director of TsNIIT, integrated teams headed by association managers and leading specialists of the institute were organized. Thus, for example, the online plant management team was headed by the deputy general director for production V. V. Otrashevskiy, while Candidate of Economic Sciences V. L. Sonkin headed the team from TsNIITU, the deputy general director for economics S. F. Dedkov headed the team for technical and economic management and Candidate of Economic Sciences N. M. Orlova headed the team from the insititute.

The members of the integrated teams analyzed and examined the automation objects. The existing units of ASU were anlayzed from the viewpoint of the tasks to be solved, their hardware, software and database organization and management to determine their further suitability for inclusion in the integrated ASU. Some tasks seemingly disappeared and were cancelled with introduction of the corresponding elements of the integrated ASU, the functional system was changed in other tasks, the solution algorithm was altered in still other tasks, while the functional part was unchanged so that the user could work according to his usual techniques.

As a result, the volume of tasks for each component of the integrated ASU was determined, but on the basis of more extensive analysis of the information flows, with regard to the hierarchy of the management levels in the association. The final composition of the components of the integrated ASU and the priority of introducing them were also determined.

Which elements of the integrated ASU are now operating at the Production Association of the Minsk Tractor Plant? These are the ASU-Association (upper level), the ASU-Plant of the head enterprise of the association and a number of computer-aided design systems and plant technology management automation systems. It is planned to introduce the assemby plant management automation system ASU-Assembly by the end of the year for the new assembly building and for the redesigned shops of the assembly plant. This will be a unique examination:

a two-level system, which cannot be separated from the plant, will be introduced for the first time in practice. The new main assembly conveyer can operate only with the existing ASU-Assembly--there are not two operating modes.

In developing the ASU-Assembly, the developers seemingly encountered a vision of the future--an automated plant of a new type. The new assembly building is not a shop in the traditional understanding. The two main assembly conveyers (GSK) of 6-10 assembly positions each are integrated with a multilevel overhead push conveyer system (PTK), which delivers the parts and assembly required for the given moment to the assembler automatically upon command of the computer. The supervisor also has new functions: his eyes become a computer display. He observes on the screen the course of production and can correct interactively with the computer one or another version of loading tractors on the main assembly conveyer.

It is natural that, to start this entire mechanism, a machine program alone is uncessary, as for machine tools with numerical programmed control. This manufacture requires development of an information management system that reflects the multiversion nature and multiprogram nature of the production process itself.

The following version of management of the assembly shop was adopted. The ASU-Assembly consists of two levels. The upper level maintains online accounting, monitoring and analysis of the course of production and these data are transmitted to the ASU-MTZ (a component of the integrated ASU). In turn, information about the production plant and so on is delivered by the plant management to the ASU-Assembly. Directive data are the basis for formulation of a sliding schedule of loading products on the main assembly conveyer, which is displayed on the display screen in the form of the version and can be corrected in the interactive mode with the computer. The selected version of the schedule in turn emerges as the basis for formulation of tasks to the supply shops and for an hourly compilation of the current tractor loading schedule.

Introduction of the current schedule, along with the sliding schedule, provides variance in management. Information about the presence of assemblies and parts on the overhead push conveyers is delivered in the automatic mode from the ASUTP-PTK to the upper level of the ASU-Assembly. This makes it possible to avoid critical situations when too few makeup units or a planned lack of makeup units remains according to some modification. Computer calculation of supply of workstations anticipates events, for example, sending messages to the supervisor about the need for extreme measures to deliver makeup parts.

The expected efficiency of the ASU-Assembly is much higher than could have been achieved by using only local automation, for example, being limited by control of actuating mechanisms of the overhead push conveyers.

Thus, the design of the integrated ASU requires doing away with very many old concepts, which corresponded to traditional forms of plant management. To conduct this work successfully, it is necessary to do away with the customary view of the ASU, in which yesterday's production was reflected. The course

taken by the tractor builders toward technical retooling of the plant on the basis of the advances of scientific and technical progress contributed largely to doing away with obsolescent layouts. But not only the appearance of the equipment at the Minsk Tractor Plant contributes to development and introduction of the integrated ASU. Personnel are even now being trained at the association to convert to "paperless technology" and this means to operation of integrated ASU. Special courses are being offered to designers, foremen, economists and technicians and practical exercises are being conducted at automated workstations (ARM) in the accustomed production situation. Every student can ascertain the advantages of working without paper and drawings, which comprises one of the main subjects of the current phase of the scientific and technical revolution, when the main information carrier will become the computer memory.

6521
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RENOVATION OF GALVANIC PRODUCTION PLANT

Minsk NARODNOYE KHOZYAYSTVO BELORUSSII in Russian No 11, Nov 86 p 28

[Article by V. Katsuk, director of mechanical production of NPO Gorizont]

[Text] During renovation of the galvanic plant, we, along with achieving the highest performance and excellent quality of coatings, devoted a great deal of attention to improving the working conditions of the workers and to improving production scales.

Unfortunately, the range of galvanic equipment for production of radio parts is not manufactured on a centralized basis and every enterprise solves these problems independently. It was literally necessary for our technical managers, designers and technicians to break their heads. They first studied the experience of the leading enterprises of the USSR and best foreign companies. They sought the experience and they found it! Our version of arrangement of galvanic production in a multistory building, where the engineering equipment, air ducts, filters, tanks with the most aggressive fluids, measuring tanks, centralized electrolyte pouring systems and much more were arranged successfully, is of undoubted technical interest to many.

Electrolytes and alkali solutions are prepared on the first floor. They are delivered to automatic galvanizing machines according to the delivery system of production fluids. The rinse waters and various types of runoffs travelled by gravity through pipelines to the cleanup tanks, located in the basement of the building, for neutralization.

Automatic machines, operating on a "rigid" program, and several flexible modules that fabricate printed circuit boards have been developed for parts of mass and large-series manufacture. The situation is complicated with parts of small-series manufacture. The list of these parts is usually very large and the types of coatings are diverse. They differ in thickness of the protective layer and the sublayer, in the chemical composition of the coatings, and in the requirements placed on their properties. Modification of these processes in hand vats is extremely labor intensive. There are many rejected parts. It is inefficient to restructure automatic machines with a "rigid" program for small series production. There is only one outcome--to develop a flexible automated system.

This system has already been developed and is being introduced at our association. It is called the plant technology management automation system Galvanika.

Structurally, the system consists of the management object--five automatic multi programmed lines: copper, nickle-chromium, zinc-cadmium and tin-bismuth coating and metal coating of printed-circuit boards (all these are many tens of programs) and a control computer system (UVK).

The system permits simultaneous handling of parts on a set of suspensions according to different production programs. The time of handling a lot of parts of given nomenclature on each multiprogrammed line is minimal. The control computer system consists of special communications devices. A real-time disk operating system is used for the common software of the plant technology management automation system.

Additional information is entered through interaction of the operator and computer. Introduction of the given system permits a reduction of the numbers of galvanic technicians involved in these processes by more than a factor of two, will increase labor productivity four-sixfold, will raise production skills incomparably and the main thing, will achieve high quality of galvanic coatings. The system, of course, requires clearer organization of production, development of the necessary production modifications and rhythmic delivery of parts from the stamping and machine shops.

6521
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[Text] Table of Contents

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On One Approach to the Representation of Fundamental Algorithms for Economic Data Processing

[Article by A.B. Lerner, Kiev Affiliate of the Design Engineering Bureau of Locomotives]

One of the mosturgent problems at the present time in the area of computer system design for economic data processing is that of reducing costs and development timeframes, as well as improving the quality of the software

systems being developed. The solution of this problem entails the development and implementation of software engineering that encompasses all stages in the life cycle of the programs (systems analysis, development of peripheral specifications, development of a program system structure, development of program modules, coding, testing and debugging as well as maintenance).

The methods of representing fundamental algorithms in the stage of developing peripheral specifications for the tasks of economic data processing are treated below. This stage can be called the stage of algorithm development for task execution and it can be represented in the form of an algorithm for computing the information-containing data structures.

The following requirements are placed on fundamental economic data processing algorithms [1]:

--That they be formalized (the components of the computational model must be understandable to a person and be sufficiently formalized for computer implementation);

--That they be structured (the structure of all transformations, starting with the requisites and ending with the structural units of the information, must be specified in explicit form or derived algorithmically);

--The informational and algorithmic completeness of the representation (the model for the descriptions must be sufficient for their computer implementation and the representation of the technical documentation);

--Machine independence (the model must reflect the interaction of the informational transformations without touching on questions of data management; the specific features of the internal machine representation of the model must not influence the description of the model);

--Adaptability to changes and modifications of the system.

When describing economic data processing algorithms, it is expedient to use economic indicators as the variables, which on one hand are semantic units of information, and on the other, are high level relations [1]. When using economic indicators to represent economic information, it is extremely effective to employ formalized rules for writing their processing procedures [2]; these rules assure the completeness and uniqueness of the description and make it possible to use the design procedure both in the stage of compiling the external specifications as well as in subsequent stages.

Designers employ several kinds of information models in each design stage. Two classes of models are distinguished in the stage of external specification development (the fundamental algorithms): the generalized description of the structure of the algorithm for the economic calculation and the description of the calculation of the economic indicators.

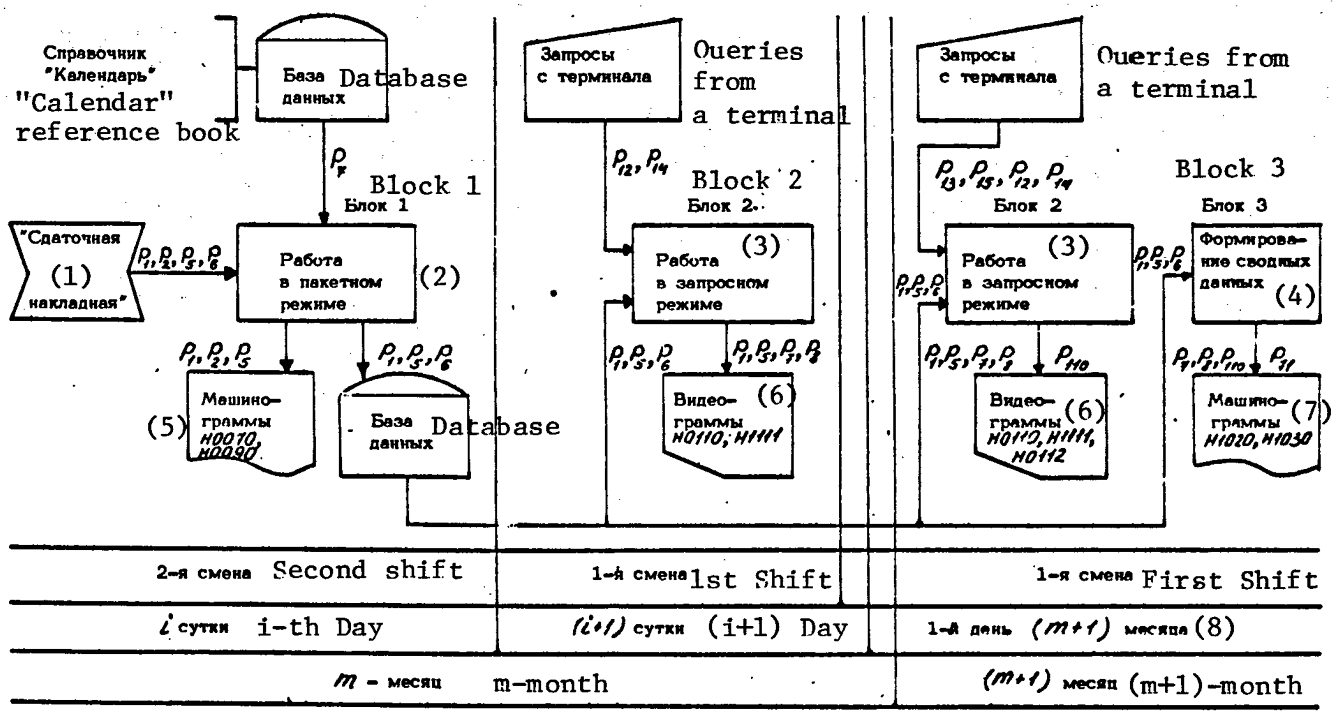

Figure 1.

Key: 1. "Delivery Invoice";
2. Operation in batch processing mode;
3. Operation in query mode;
4. Summary data generation;
5. Computer-plotted graphs, H0070, H0090;
6. Graphics displays, H0010, H1111;
7. Computer-plotted graphs, H1020, H1030.

The first class of descriptions is realized by means of structured schemes for the task algorithms, which define the major functional parts of the algorithm and the relations (time and information relations) between its parts. A graphic form provides a clear representation of the functional components of the algorithm as well as the information (at the level of the economic indicators) and time relationships between its parts, between the given task and the other parts of the system (Figure 1).

The functional components of the algorithm in the scheme are depicted in the form of rectangles. The decomposition of a task into parts (blocks) is accomplished taking into account the periodicity and timeframes for the performance of the individual calculations, the minimization of the informational (in the form of the economic indicators) linkages between the blocks and the functional completeness of the individual calculations. The block diagram shows the sources for obtaining the input economic indicators (other tasks and queries), the output video displays and computer printouts, as well as the tasks for which the indicators are intended that are generated in the given task. In order to describe the points in time of task execution for tasks that are sources and consumers of information, all of the task blocks in the block diagrams are associated with discrete points in time.

The algorithm flow charts considered here are used to describe the results of the step by step decomposition of a task into independent (local) blocks, which enables the development of a formulation algorithm by several designers, and promotes a reduction in the complexity and size of the task. The block diagrams are also used for familiarization with the major calculations performed in the task in the various stages of the design and operation of the system.

The second class of descriptions is realized in the form of schemes for the intratask information linkages. The application of graph theory, the language of which proves to be the clearest and most convenient in the description of information flows and the synthesis and equivalent transformations of automated mangement system algorithms, makes it possible to have a unique and compact description of economic calculations. The schemes of the intratask information linkages, represented in the form of a weighted graph of indicators, provide a clear idea of the sequence for obtaining all of the input and intermediate indicators as well as concerning the tasks supplying the output information (Figure 2). Each indicator in the scheme is depicted by a small circle, in which the indicator identifier and the number of the procedure for generating it are indicated. The indicator is joined by arrows to those indicators that are used directly for generating it, as well as to the indicators, computer-plotted graphs, graphics displays and tasks in which the given indicator is employed. Specification sheets for the indicators are being developed for the input, output and stored task indicators and its blocks. For the sake of clarity, the schemes indicated above show the fundamental computational formulas in analytical form. Complete specifications of the calculations of the economic indicators are given in subsequent lists of the schemes in a form close to the rules for writing the indicator processing procedures [2].

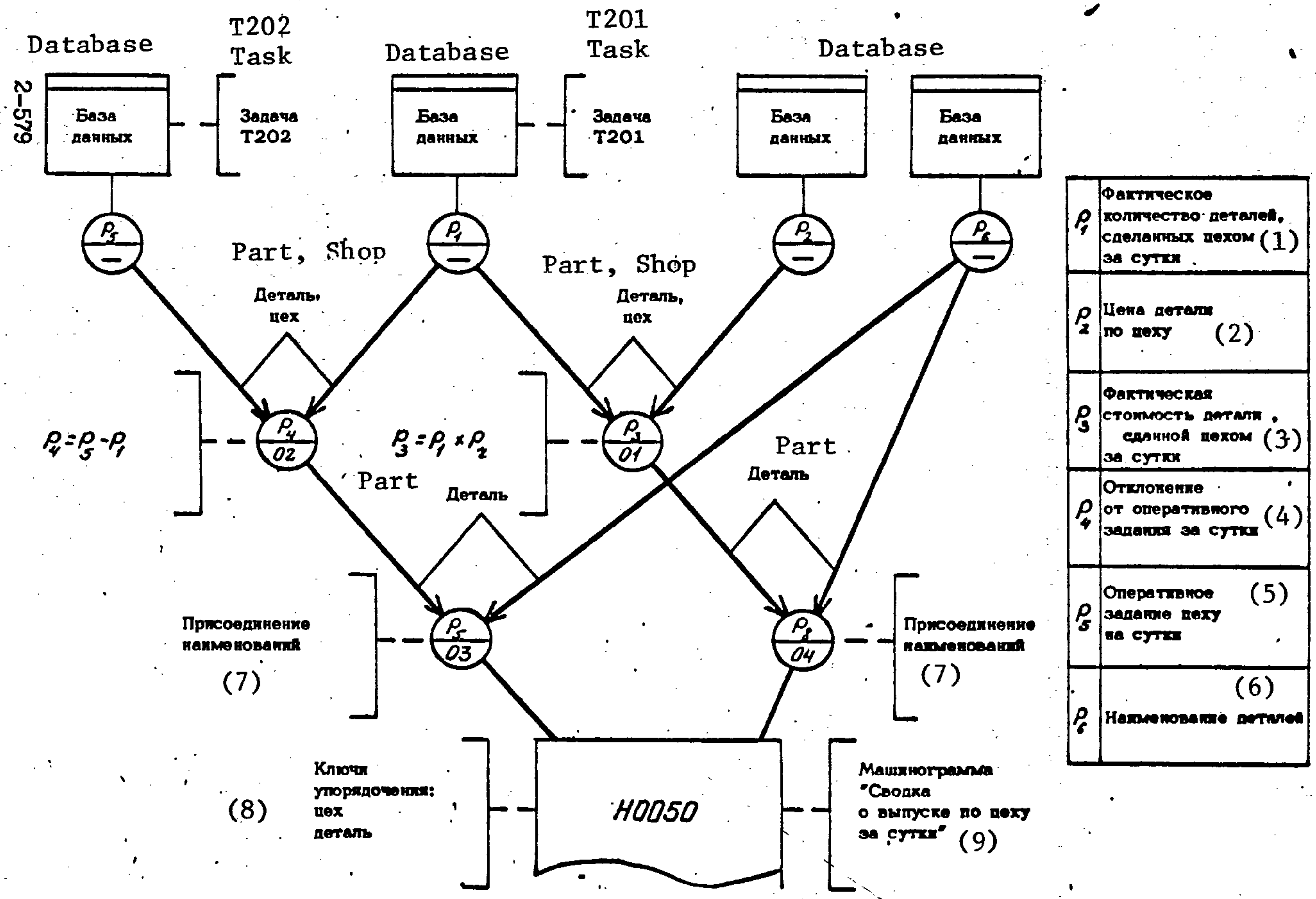

Figure 2.

Key: 1. Actual number of parts made by the shop per day;
2. Shop price of the part;
3. Actual cost of the part delivered by the shop per day;
4. Deviation from the on-line job assigned, per day;
5. On-line job for the shop, per day;
6. Designation of the parts;
7. Assignation of the designations;
8. Keys for establishing the order: shop, part;
9. Computer printout: "Summary of the per Shop Output per Day".

The means considered for the description of economic data processing algorithms conform to the requirements given above. Thus, a formalized structure is assured through the description of the economic information in a specialized language of economic indicators [3], by the means for describing the procudures for calculating them [3] and by the means for representing the algorithm flow charts and the intratask information linkages. Structuredness is achieved by means of describing the calculation of all economic indicators and the logical structures of the documents utilizing these indicators. Informational and algorithmic completeness of the fundamental algorithm assures the construction of implementation algorithms, as well as the description and design of files and databases [4, 5, 6, 7]. Machine independence is due to the fact that the data management or intramachine representation aids are not used in the description of the problem-oriented algorithms. Adaptability can be assured by means of a system for making changes manually, or considering the high level of formalization of the fundamental components of algorithm representation, by means of utilities for computer-aided management of the model.

Experience with the implementation of the software engineering system for plant management automation systems, within the framework of which the task formulations are described by means of the methods considered above for the representation of the fundamental algorithms at the level of economic indicators already exists. Within the framework of this technology, two stages of a standard plant management automation system have been developed for plants that repair freight cars and the first stage of a standard plant management automation system is under development at the present time for plants that repair rolling stock and manufacture spare parts for the USSR Ministry of Railroads.

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UDC 025.4:002:681.3

On Evaluating Possible Elimination of Manual Encoding of Technical and Economic Data in Automated Data Processing Systems

[Article by V.G. Shcherbakov and I.V. Golikov]

The storage and processing of descriptive technical and economic data in a computer are accomplished in coded form, which makes it possible to reduce the volume of the stored information by a factor of 5 to 10 times as well as facilitate the retrieval and processing of the data. Two coding variants have been adopted.

The first variant is encoding by hand, in which a classification system (in a form that a person can read) is used to encode the data prior to its input into the computer.

The second variant involves the input of the data in a form natural to man, and then the data is coded by the computer: automated encoding.

The use of the first variant makes it possible to reduce the labor expenditures for data preparation (tape punching, key punching on a display keyboard) and the second enables a reduction in the labor expenditures for data encoding.

We shall analyze the specific features of each of the above for the purpose of selecting the optimal coding variant.

As compared to automated coding, manual coding makes it possible to substantially reduce (by a factor of n times) the number of characters fed into the computer, i.e. curtails the volume of work related to preparing the machine media. The value of n can be determined from the formula:

$$n = \frac{1}{N} \sum_{j=1}^{N} \sum_{i=1}^{S_j} \left(\frac{a_{ij}}{b_{ij}} \delta_{ij} \right), \tag{1}$$

where: N is the number of classification systems employed;

K_j is the number of concepts contained in the j-th classification system;

a_{ij} is the length of the designation of the i-th concept of the j-th classification system, in characters;

δ_{ij} is the usage frequency of the i-th concept of the j-th classification system;

b_{ij} is the lenght of the code of the i-th concept of the j-th classification system, in characters;

$$\delta_{ij} = \frac{m_j(i)}{M_j},$$

where: $m_j(i)$ is the number of i-th concepts encoded during the same time interval by means of the j-th classification system;

$M_j = \sum_{i=1}^{K_j} m_j(i)$ is the overall number of concepts encoded by means of the j-th classification system during a specified time interval (year, quarter, month, etc.).

As a rule, the code length in the classification system is chosen as a constant, i.e. $b_{ij} = b_j$, and then expression (1) assumes the form:

$$n = \frac{1}{N} \sum_{j=1}^{N} \left(\frac{1}{b_j M_j} \sum_{i=1}^{K_j} (a_{ij}\, m_j(i)) \right). \tag{2}$$

In practical terms, the quantity n in automated data processing systems (ASOD) for nonindustrial applications varies in a range of from 3 to 10.

The advantage of coding by hand is also the capability of protecting the data prepared for input into the computer against undesirable visual observation of it (by computer center personnel).

The advantages of manual coding must also include the capability of bringing order to the terminology employed by geographically separate automated data processing system subscribers and used in the classification systems, as well as the heading writing systems and coding tables.

A drawback to coding by hand, besides the primary drawback related to the necessity of someone performing the coding operations, is the need for a multiple copy printing system and the dissemination and updating of manual classification systems. The labor expenditures for the support of such a system and its slow response time increase in step with the increasing number of persons involved in the coding, as well as the number and geographical remoteness of the locations where the coding is done. Considering the fact that a person, as a component of a man-machine system, can commit errors, the assuring of a high data reliability during manual coding as well as promptness of the coding, requires considerable labor outlays. The fact additional functions related to the coding are assigned to the personnel of the system being automated also has a negative impact on the introduction of an automated data processing system. Because of this, it becomes necessary to employ coding clerks, whose work, on one hand, requires little skill and is unattractive, while on the other, requires a high degree of responsibility.

Manual coding precludes the possibility of using primary documents for the preparation of the machine media, since the information contained in them is represented in a natural language and in a number of cases, there is no place for writing the codes and the requisite auxiliary information (dividers, end of document symbols, a registration number, etc.).

In contrast to manual coding, automatic coding eliminates the labor expenditures for training and the performance of the coding operations, the quality control of the coding correctness, as well as the labor expenditures for the preparation, distribution and accounting for the classification systems and keeping them updated, substantially enhances the reliability of the data fed into the computer, because of the redundancy inherent in a natural language and also provides for semantic checking in all stages of document preparation for computer input. In the case of automatic coding, it becomes possible to employ the primary documents of the automated system as the input documents for the automated data processing system.

Factors that make it difficult to use automatic coding, besides the one indicated above (the significant increase in the symbols fed into the computer as compared to manual coding), must also include the necessity of utilizing considerable computer resources that can be provided at the present time only in systems based on computers no lower than the YeS-1035 class. The known automatic coding packages require up to 300 Kbytes of main memory and no less than two disk drives.

A comparison of these coding techniques as a function of the labor expenditures needed to implement them is given below.

The labor expenditures for manual coding (T_{rk}) can be determined from the following expression:

$$T_{rk} = T_0 + T_k + T_{kk} + T_{vi} + T_p + T_{vp} + T_{ii} + T_t + T_{tii} + T_r + T_r + T^{rk}_{pd} + T^{rk}_{kpd} + T^{rk}_{iosh}, \quad (3)$$

where:

T_0 are the labor expenditures for coding training and monitoring the coding correctness;

T_k are the labor expenditures for the manual coding;

T_{kk} are the labor expenditures for monitoring the correctness of the coding [sic];

T_{vi} are the labor expenditures for making changes in the working copies of the classification systems;

T_p are the labor expenditures for the development and fabrication of the originals and certified copies of the classification systems;

T_{ii} are the labor expenditures for the development of notifications of a change;

T_t are the labor expenditures for the making of working copies of classification systems;

T_{tii} are the labor expenditures for the making of duplicate copies of notifications of a change;

T_r are the labor expenditures for accounting for and distributing the classification systems and notifications;

T^{rk}_{pd} are the labor expenditures for the preparation of the machine media of the input documents;

T^{rk}_{kpd} are the labor expenditures for monitoring the correctness of the machine media preparation;

T^{rk}_{iosh} are the labor expenditures for correcting coding errors and preparing the input document media.

The labor expenditures for automatic coding (T_{ak}) can be determined from the following expression:

$$T_{ak} = T^{ak}_{k} + T_{ms} + T_{vms} + T^{ak}_{pd} + T^{ak}_{iosh} \tag{4}$$

where: T^{ak}_{k} are the normalized labor expenditures for servicing and using a computer for automatic coding;

T_{ms} are the labor expenditures for the development and generation of machine dictionaries in the computer;

T_{vms} are the labor expenditures for making changes in the computer dictionaries;

T^{ak}_{pd} are the labor expenditures for the preparation of the machine media for the input documents in the case of automatic coding;

T^{ak}_{iosh} are the labor expenditures for correcting errors in the preparation of the machine media of the input documents.

The determination of the values of the parameters in expression (3) as well as the parameters T_{ms} and T_{vms} included in expression (4) presents no difficulties for specific automated data processing systems.

The rules for determining the values of the parameters T_{ms} and T_{vms} are given in the description of the selected package that supports the automatic coding.

The selection of the coding method, from the viewpoint of the labor expenditures, reduces to the determination of:

$$\min\{T_{rk}, T_{ak}\}$$

The advantages of coding by hand over automatic coding will disappear with the development of the means of automatic data input into computers from the primary documents (speech input systems, character recognition automata) as well as with the increase in the capacities of main and disk memories, and consequently, the problem of comparing them will become meaningless.

However, using the formulas given above, one can even at the present time determine the application where the elimination of manual coding is economically justified.

UDC 002:681.3.01

Questions of Database Reliability Assurance for the Sectoral Management Automation System of the UkSSR Ministry of Education when Using a Database Management System

[Article by V.Ye. Bykov, candidate of technical sciences, M.Ya. Pleskach and O.B. Dolinny, Main Computer Center of the UkSSR Ministry of Education]

The considerable volumes of data processed and stored in the sectoral management automation system of the UkSSR Ministry of Education and its multipurpose utilization for solving an extensive class of problems place special requirements on the database reliability. In this case, questions of assuring the integrity of the database become quite important [2, 3].

A distinction is drawn between the syntactic and semantic integrity of a database [2].

Questions of developing and implementing universal procedures that provide for and maintain the semantic integrity of a database are treated below.

Taking the approach of database management systems (DBMS) used as the nucleus of the software for the management automation system, the attainment of syntactic integrity of the database is facilitated considerably: DBMS's having aids for loading data into the bases possess adequate tools for structured quality control of the data.

The tasks of assuring the semantic integrity of a database are usually assigned to the designer. In this case, local software is created that is strictly oriented towards the execution of particular monitoring operations for a single document or a set of documents. This software is unstable with respect to the frequently changing structure of the primary documents, which is characteristic of the education sector. This leads to the correction of the programs that maintain the semantic integrity of the database and the data processing operations are made substantially more complex in this instance.

The development of universal proedures will make it possible to expand DBMS capabilities as regards the maintenance of semantic integrity of a database and standardize the data processing procedures in an environment where a DBMS is used.

Two fundamental trends are discerned in the development of universal procedures.

The first approach is based on the combining of the functions that assure the syntactic and semantic integrity in a single program and assumes an operating mode of the system such that the document cannot be loaded into the base until

it is acknowledged as correct by the system from the viewpoint of syntax and semantics. In this case, one can consider a DBMS that permits the connection of user modules that support the semantic integrity of the data base during the loading of the information into the database. In this way, the question of database integrity is fully resolved in the step of the pre-base processing of the data. This question can also be resolved independently of the particular DBMS by means of the appropriate applied program packages (PPP's) and a program interface between the "pre-base medium" and the database.

The second approach is based on the separation of the functions that assure syntactic and semantic integrity. In this case, the quality control procedures are carried out following the loading of the data into the database and can be implemented independently of the orientation towards a particular DBMS.

The second approach is employed, since the DBMS used as the basis for the software under development was the relational PALMA-OS version 4.2 structure, which possesses powerful aids for loading data into the database. The lack of connection points for user modules also argues in favor of this approach.

The process of implementing universal monitoring procedures related to the maintenance of the semantic integrity of a database presupposes the execution of those same operations that an economist performs when checking reports: checking for the presence of the reports, collating the data with check sums, checking the codes, checking the key indicators and their permissible limits, balance sheet and arithmetic checking, ascertaining relationships between individual indicators of a particular report and the indicators of other reports, comparing the data of past periods with plan data, etc. All of these types of operations are classified in paper [1].

It is possible to create quality control relation files on the basis of the formalization of these operations. It is expedient to create these files in accordance with the types of relations (files for internal form linkages, interform linkage files), since the periodicity of changes in the quality control relations differs.

In the general case, the formulas of the check relations can be represented in the form of the expression:

$$f_K\ (A, B, C, D, \ldots)\ R\ \varphi_K\ (A, B, C, D, \ldots),\ K = \overline{1, m}, \tag{1}$$

where f_K and φ_K are expressions that obey the simplest syntactic rules;

R belongs to the set: $R \in \{=, >=, <, >, \ldots\}$;

A, B, C, D are symbols used to designate data, which identify the elements of the data being checked.

The alphabet of the description language for the check relations is a subset of the PL/1 language.

We shall cite examples of some of the relations:

$$A(i,12) >= A(1,1); \quad i = 2\text{-}10;$$
$$A(3,5) + B(1,2) < C(5,6);$$
$$A(5,j) + B(2,j) >= C(1,j); \quad j = 10\text{-}15;$$
$$B(i,j) + C(i,j) - D(i,j); \quad i = 1\text{-}5; \; j = 4\text{-}5;$$
$$A(i,1) * B(i,3) >= C(i,4); \quad i = 3\text{-}12.$$

The loading of the formulas of the control relations in the file base and their management must be accomplished by the DBMS software.

The concepts and approaches to the design of universal quality control procedures considered here are realized in a package of applied programs (PPP) for assuring the semantic integrity of databases using the PALMA-OS version 4.2 DBMS [4]. This package was developed within the framework of the sectoral management automation system under development in the Main Computer Center of the UkSSR Ministry of Education.

The applied program package includes off-line loading modules that make it possible to do the following:

--Check documents for repeatability with respect to specified key requisites;
--Print out a hard copy of the original data in the form of a prototype primary document in accordance with an arbitrary logic condition, indicating the addresses of the groups of requisites relative to this condition;
--Check documents with respect to the classification systems;
--Print out a hard copy of the control relations for the intraform and interform quality control;
--Carry out the intraform checking of the documents;
--Execute the interform checking of the documents;
--Statistically analyze the passage of the documents through the quality control steps.

The concepts of the PALMA-OS DBMS were used in the process of developing the package. This approach enabled an extremely efficient solution of the problem of checking the documents for repeatability and checking them with respect to the classification systems. The utilization of type 0 and I patterns enabled direct access to the groups of requisites and individual requisites during the process of search and modification. The relational interface data language provided additional capabilities of searching for and manipulating system objects.

The proposed implementation of the package makes it possible to interact efficiently with the DBMS in a database multiple accessing mode.

An error diagnostic protocol is generated as a result of checking by the package; this protocol is produced in a tabular form convenient for the user, where this form tranmits the structure of the input document. The table contains relational error domains and the addresses of the groups of requisites produced by the package. The addresses generated by the package are used to provide direct access to the data during correction (in accordance with the type 0 pattern).

The package developed for maintaining semantic integrity was tested and proved viable in the sectoral management automation system of the UkSSR Ministry of Education based on the data sheet specifications for the general educational schools, which contain about 1,000 documents characterizing the managed facility. More than 100 formulas of the kind of (1) were used to describe the correlations between the domains of the relation being checked. The required memory capacity is no less than 120 Kbytes; the programming language is PL/1. The proposed package can be used in management automation systems for other sectors.

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UDC 002:65.011.56:681.3

DEVELOPMENT OF REAL-TIME PRODUCTION PROCESS ACCOUNTING SYSTEM USING THE SMALL COMPUTER SYSTEM

[Article by V.Z. Kurunyan, N.A. Nechayev and V.I. Iodlovskiy, candidate of technical sciences]

An automated real-time industrial process accounting system (ASOU) is being developed on the basis of the complex of data preparation and collection aids (KSPD-1), which is designed around the SM-1P processor, incorporated in the system of small computers (SM EVM) and controlled by this system.

The data preparation and collection complex provides for the following:

--Remote collection of digital and alphanumeric data on the course of the production process by means of console-type data recorders installed directly in the shops, sections and warehouses for the finished products (in real time);

--Data transmission via communications lines;

--Generation of messages in the main memory;

--Processing the messages in accordance with the specified message format;

--Data storage in peripheral stores (on magnetic tape or magnetic disk);

--Message search at the operator's request and the display of the message at the terminal;

--Off-line operation of all of the data recorders incorporated in the system;

--The execution of on-line control tasks in accordance with user programs in the time free of data reception;

--Communications with the top level computer (a YeS computer or the M-4030) directly through a special interface.

The automated real-time process accounting system based on the KSPD-1 performs the following functions:

--Collecting and processing the data on the status of part (or assembly) fabrication according to shops or sections;

--Accumulation and storage of data on the status of part (or assembly) fabrication according to shops and the manufacturing operation as a whole;

--The generation and delivery of documents and information on the state of the manufacturing process to the users;

--The generation and management of the file of standards and reference information.

The system has three information processing levels:

--Information recording and collecting stations, which are set up in the shops and provide for the collection of real-time data and its remote transmission from the RI-6402 console recorders via communications channels to the control computer system (UVK), a SM-1 computer;

--A subscriber information station, which receives and monitors the on-line data in the SM-1 control computer system and also stores, processes and displays the processing results for the system users on a "Videoton-340" display module and an DZM-180 printer;

--The computer center that provides for the preparation and management of the standards and reference information files; this information is used for task execution in the KSPD-1 as well as the solution of analysis problems on the YeS computers.

The primary document in the automated system for on-line production operation accounting is the "Bill of Lading", which is drawn up in the shops for the intrashop and intershop transfer of a batch of parts and is turned over to the data collecting and recording station that services the given shop.

In the time established for data collection, the SM-1 control computer system sequentially interrogates the data recorders, and after they are turned on, displays the readiness signal. The operator feeds in the messages for establishing the formats from the keyboard of a typewriter. When the data is fed via a communications channel to the SM-1 control computer system, a check printout can be made using the recorder's paper roll.

The daily working file is set up on a magnetic disk using the information incoming from the recorders; this file is the basis for the creation of a base monthly file with data on the status of part (or assembly) fabrication according to orders, starting batches, shops and sections.

The functions of the automated system for on-line accounting arerealized by means of the following tasks:

--The generation of the on line working information file concerning the state of the manufacture of the parts;

--Accounting for the movement of parts in the manufacturing process during a month;

--Generating and issuing reference documents for the state of parts' movement in the manufacturing process;

--Generation and management of the following files: "Reference Data on the Designations of Assemblies (or Parts) and the Shop-to-Shop Flow Sheet" and "Production Process for Manufacturing the Parts (or Assemblies)."

The task "Generating the On-Line Information File for the Status of Part Fabrication" is the initial task in the set of tasks and provides for the following:

--Real-time retrieval of the data on the course of production in the shops by means of the RI-6402 console recorders, installed directly at the data origination points;

--Programmed logic monitoring of the received messages with errors indicated on the console recorder;

--The writing of the checked messages into a magnetic disk file;

--Generation of the daily on-line file and the sorting of the file;

--Monitoring the individual requisites for their existence in the standards and reference data file;

--Correction of the daily on-line working file;

--Printout of the messages received during the day in the form of a waybill document;

--Accumulation and generation of the base file with the on-line working information concerning the manufacturing status of the parts (or assemblies) in of the shops and sections for the month;

--The generation and presentation of the documents on the manufacturing status of the parts and assemblies in the shops to the management of the plant subdivisions and services.

The task "Accounting for Parts Movement in Manufacturing during a Month" provides the management of the subdivisions and services of an enterprise with information on the manufacturing status of each part located in the fabrication shops. The parts movement document is generated and printed out in this task. In order to executed the task, the initial data are the base file for parts accounting, which is updated daily, as well as the standards and reference file of assemblies (or parts) designations and the shop-to-shop flow sheet file.

The task "Generating and Issuing Reference Data on the Status of Parts Movement in Manufacturing" provides the management of the plant subdivisions and services with information concerning the manufacturing of the parts with respect to the status at the beginning of the current day (or shift) by means of data output on a "Videoton-340" display module installed at the user's location. The user works in a "query and response" mode during the period of time set aside for him, following the daily correction of the base file. At the user's request, the information can be printed out on a DZM-180 printer. A provision is made in the task for multiple query input.

The implentation of the task makes it possible to curtail the search time for data on the manufacturing status of a part (or assembly) from several tens of minutes down to 40 seconds and is an example of the changeover in task execution to a paperless data processing technology.

The task "Generation and Management of the Files", "Reference Book on Designations of Assemblies (or Parts) and Shop-to-Shop Flow Sheet" and "Technical Manufacturing Process for the Parts (or Assemblies)"generates the standards and reference data files for the first three tasks of the set [sic].

The introduction of the real-time automated data accounting system based on the complex KSPD-1 recorders has enabled the following: the assurance of product output regularity with continually increasing production volumes; the organization of the manufacturing data accounting for the parts, assemblies, packages and complete sets in the shops, according to sections; the providing of the management of plant services with real-time data necessary for production planning, control and quality control.

The capability of making the transition to the next stage in the development of real-time automated operational data accounting in manufacturing has thus been assured: the automation of the monitoring and analyzing of the execution of the progress chart.

II. Development and Classification Systems and the Unified System of Documentation

UDC 025.4:339.6:658.566

The Coding of Valuable Physical Assets in the USSR Ministry of Power Engineering and Electrification (by Way of Discussion)

[Article by Yu.V. Kiselev (Sverdlovenergo), Yu.A. Shadynts (TsDU YeES SSSR [Central Dispatcher Administration, USSR Unified Energy Administration], I.S. Yarnykh (Ekonomtekhenergo P/O Soyuztechenergo [not further identified]

A sectoral classification system for material and technical supply subjects (KPMTS) has been developed in the USSR Ministry of Power Engineering and Electrification. The objects of the sectoral classification system encoding are commodity and material assets used in the manufacturing and nonmanufacturing areas of activity of associations, power systems and organizations.

The basis for the KPMTS is the All-Union Classification System for Industrial and Agricultural Products (OKP).

The basic set of commodity and physical assets includes (Figure 1):

--Products of Soviet manufacture, included in the OKP;

--Imported products included in the OKP.

The KPMTS additionally contains a product list of commodity and material assets lacking in the all-union product classification system. These include the following:

--Products taken out of production, but which are being used in the sector up to the present time;

--Imported products, not listed in the A-OKP;

--Products manufactured using one's own resources or for individual orders.

Each item of the KPMTS classification system contains the following requisites:

--The decimal code;
--The check number;
--The category of the code;
--The complete name, type and standard size of the product;
--The designation of the engineering standards setting document that determines the product characteristics;
--The code for the measurement unit in accordance with the System of Designations of Measurement Units Employed in Automated Control Systems (SOYeI);

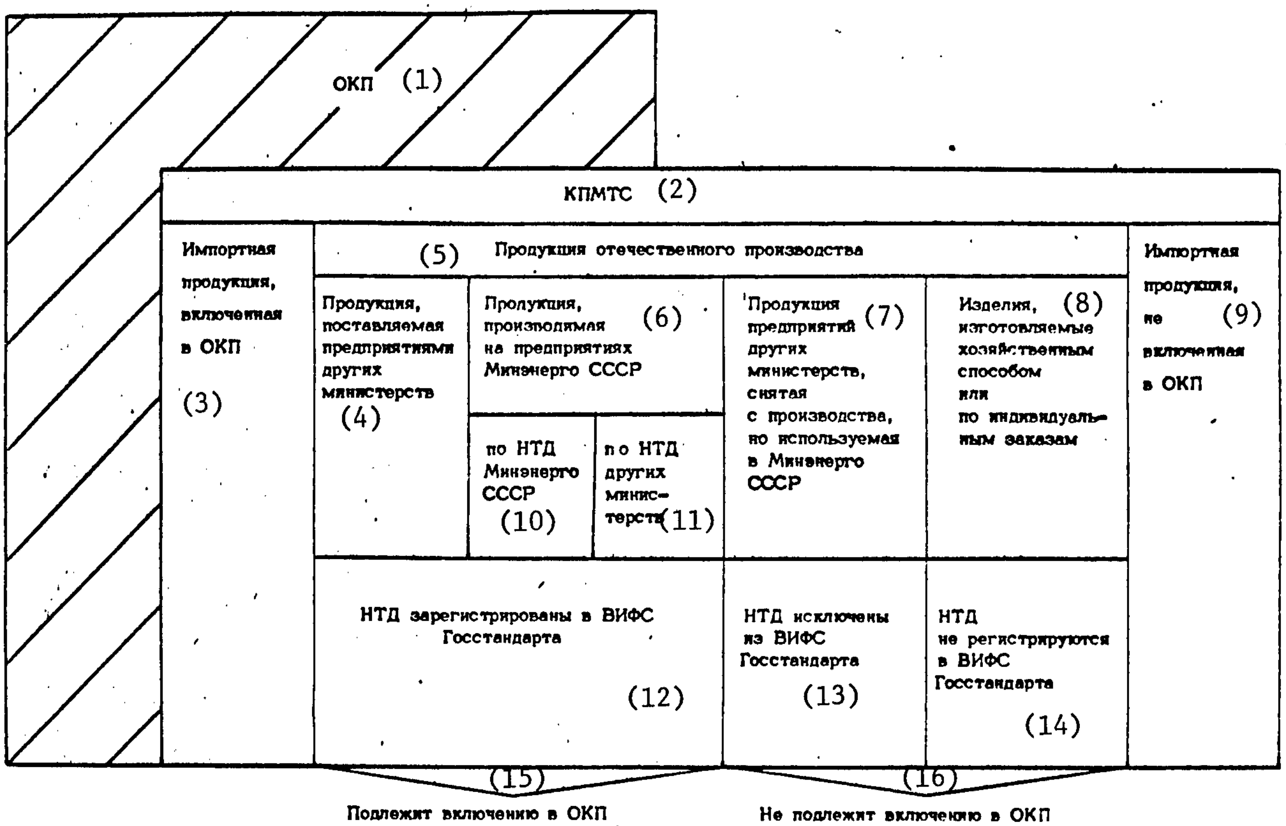

Figure 1.

Key: 1. OKP [All-Union Classification System for Industrial and Agricultural Products];
2. KPMTS [Sector Classification System for Material and Technical Supply Objects];
3. Imported products included in the OKP;
4. Products supplied by the enterprises of other ministries;
5. Soviet manufactured products;
6. Products made by the enterprises of the USSR Ministry of Power Engineering and Electrification;
7. Products of enterprises of other ministries, taken out of production, but used in the USSR Ministry of Power Engineering and Electrification;
8. Products manufactured using one's own resources or for individual orders;
9. Imported products not included in the OKP;
10. In accordance with the standard setting technical documentation of the USSR Ministry of Power Engineering and Electrification;
11. In accordance with the standard setting technical documentation of other ministries;
12. Standard setting technical documentation registered in the All-Union Information Fund for Standards and Technical Specifications of the USSR State Committee on Standards;

[Key to Figure 1, continued]

13. Standard setting technical documentation excluded from the All-Union Information Fund for Standards and Technical Specifications of the USSR State Committee on Standards;

14. Standard setting technical documentation not registered in the All-Union Information Fund for Standards and Technical Sepcifications of the USSR State Committee on Standards;

15. To be included in the OKP;

16. Not to be included in the OKP.

--The abbreviated form of the measurement unit;
--The product price in accordance with the all-union and sectoral price lists;
--The number of the price list;
--The number of the position (page of the price list);
--The numbers of the balance accounts and subaccounts for the primary activity and capital construction from the sectoral classification system: "Analytical Accounting Objects for the Bookkeeping Accounts Plan".

The structure of the code assigned to commodity and physical assets in the KPMTS is similar to the structure of the A-OKP code. If a product code exists in the A-OKP and is known to the user, then this code is used directly in the KPMTS.

Commodity and physical assets lacking in the OKP are encoded with local codes that include six bits from the K-OKP [sic] and four bits of the internal-type groupings from among the number of unoccupied positions in the A-OKP.

Local codes comprise about 30% of the KPMTS products list.

In addition to the all-union and local codes, temporary codes are also used in the sectoral classification systems of material and technical supply objects; the share of these temporary codes is about 20% of the total volume of the classification system. The use of temporary codes is due to the following factors:

--The long timeframes involved in the publication of OKP classes and amendments to them;
--The limited number of copies published for OKP classes, amendments and supplements to them;
--The lack of information exchange concerning the K-OKP and A-OKP using machine media;
--The lack of OKP codes in a number of all-union and in a majority of sectoral price lists;
--The nonconformity of the data on the same product in all-union and sectoral price lists in a number of cases, as well as in price lists and the OKP (in particular, the codes, designations, standard technical data and prices);
--The lack of all-union OKP codes and an understandable, adequately complete designation of the products in the documents accompanying the delivered products.

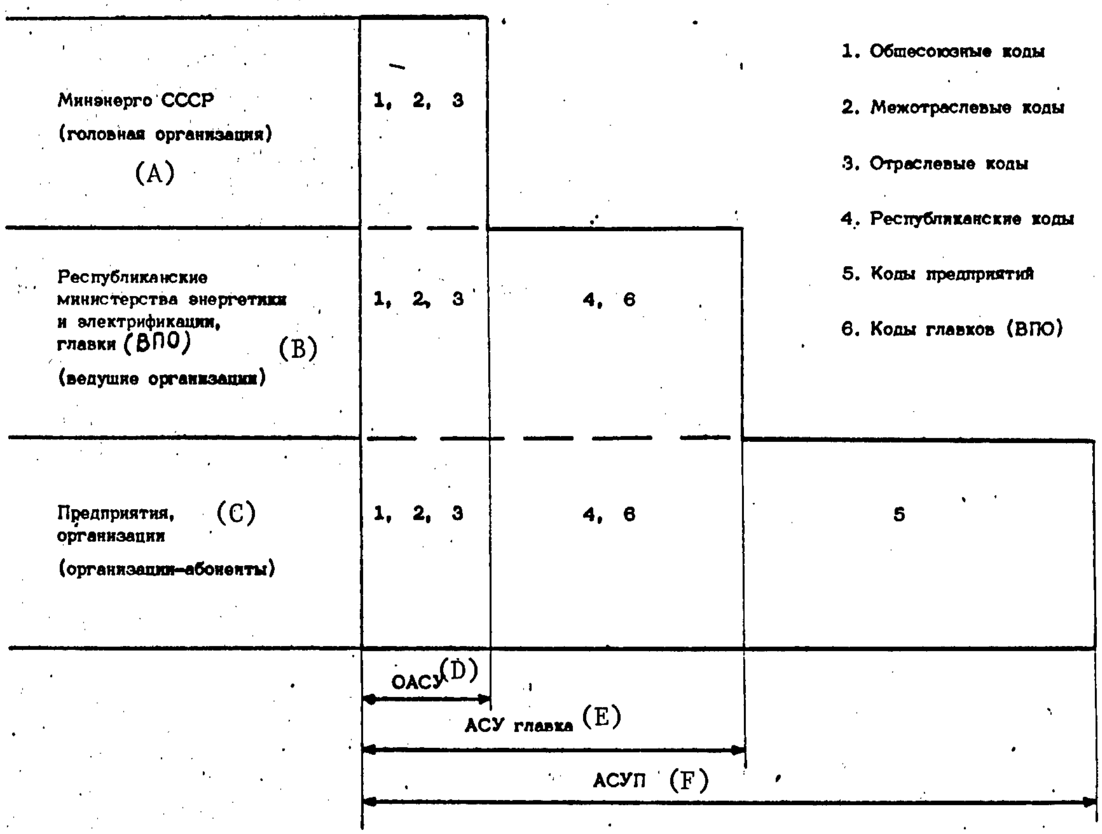

Figure 2.

Key:
1. All-union codes;
2. Intersectoral codes;
3. Sectoral codes;
4. Republic codes;
5. Enterprise codes;
6. Main administration codes (all-union production associations);

A. USSR Ministry of Power Engineering and Electrification (head organization);
B. Republic ministries of power engineering and electrification, main administrations (all-union production associations) (managing organizations);
C. Enterprises, organizations (subscribing organizations);
D. Sectoral management automation systems;
E. Management automation system for a main administration;
F. Plant management automation systems.

The use of temporary and local codes was necessitated by the need for prompt encoding of products during the automated accounting for them in the "Bookkeeping", "Power System Repair", "Material and Technical Supply Management" and other subsystems.

The procedure established at the present time for the centralized management of the OKP (including the generation of codes in accordance with one-time requests) also does not provide this timeliness.

Centralized management of key product lists which are discriminated at each management level is taken as the basis of the sectoral management system for the KPMTS in order to accelerate the process of encoding the products. The management levels in the KPMTS are identified by the reference requisite: "Code Category". Its meanings are identical to the kinds of categories of classification systems in accordance with GOST 17369-85. Thus, at each level, the centralized management system for the KPMTs encompasses a limited list of products (Figure 2).

The following materials in the process of encoding the products at all levels of management as the primary sources of information:

--Printed publications of the OKP classes and supplements and amendments to them;
--All-union and sectoral price lists and supplements and amendments to them;
--Product lists for equipment and products series produced by a particular sector (by years);
--Standards and technical specifications;
--Product lists for the products of the primary manufacturing operation (by years) of specific plants;
--Catalogs of manufactured products.

Experience with the implementation and management of the KPMTS in the USSR Ministry of Power Engineering and Electrification has shown that a reduction in the percentage of temporary and local codes is possible given the following conditions:

--The obligatory fulfillment by the suppliers of the established requirements for completing the accompanying documents for a product;
--Organizing data exchange on machine media in the all-union system for OKP management, instead of sending out printed publications of OKP classes;
--Assuring the correspondence of the codes in the printed publications of OKP classes and price lists, since the price lists are the major financial documents for calculations by product suppliers;
--Including the management of the OKP in an automated system using information exchange via communications chanels.

The creation of the KPMTS and the organization of a sectoral system for its management will make it possible to implement the OKP at enterprises and organizations of the USSR Ministry of Power Engineering and Electrification.

UDC 025.4.003.13:002

On the Determination of the Cost Effectiveness of the Implementation of All-Union Classification Systems for Technical Economic Information

[Article by N.G. Palamarchuk]

The fundamental procedural principles for the determination of the cost effectiveness of standardized documentation systems (USD) established by the USSR State Committee on Standards are analyzed in paper [1]. The principles for performing calculations of the economic impact of the implementation of all-union classification systems for technical economic information (OK TEI) are given below.

When calculating the cost effectiveness of the implementation of technical and information all-union classification systems in management automation systems at all management levels, the primary sources for generating economic savings through the elimination of the costs of the development of local classification systems (sectoral, republic and enterprise systems) are taken into account; also considered are the reductions in the cost of managing local classification systems and the recoding of data in the interaction of the management automation systems of different sectors and levels as a result of the elimination of manual labor.

When calculating the cost effectiveness of the implementation of the OK TEI, its primary parameters are defined: the annual economic savings and the cost effectiveness coefficient.

The annual economic savings, E_g, from the implementation of the OK TEI is defined as the difference between the total annual savings E obtained as a result of the implementation of the all-union classification systems for technical and economic information and the costs, Z, for their development, normalized for a single year:

$$E_g = E - C_n \cdot Z \qquad (1)$$

where C_n is the normative cost effectiveness coefficient.

The calculated cost effectiveness coefficient, C_r, is defined as the ratio of the total annual savings to the costs of the development of the OK TEI:

$$C_r = E/Z \qquad (2)$$

The calculated cost-effectiveness coefficient is compared with the norm, C_n, and if $C_r \geq C_n$, the implementation of the OK TEI is considered to be cost effective.

We shall deal with the procedure for calculating the primary cost effectiveness indicators for the implementation of an all-union classification system in the management automation system for one of a sector's enterprises (or associations).

The annual economic savings, E_{gp}, of the implementation of the all-union classification system at an enterprise is given by the formula:

$$E_{gp} = E_p - C_n \cdot Z_p \qquad (3)$$

where E_p are the total annual savings from the implementation of the all-union classification system at the enterprise, in thousands of rubles; $C_n = 0.15$ for standardization (in accordance with GOST 20779-81); Z_p are the developmental costs of the all-union classification system, referenced to the given enterprise, in thousands of rubles.

The economic impact of automated management of the all-union classification system will be higher than in the case of operation by hand; for this reason, we shall consider only manual management in these calculations. The economic impact of centralized management of an OK TEI is calculated individually in accordance with the corresponding standard setting documents.

Taking the conditions given here into account, the overall annual savings at an enterprise, E_p, can be determined from the following formula:

$$E_p = Z_1 \cdot N_1 \cdot T + Z_2 \cdot N_2 \cdot b_2 + Z_3 \cdot N_3 + b_3 - (P_1/P_2) \cdot Z_4 \cdot N_4 \cdot b_4 \qquad (4)$$

where: Z_1, Z_2, Z_3 and Z_4 are the average annual wages of the workers engaged in the development of the enterprise classification system, recoding the data, managing the enterprise classification system and the all-union system replacing it, taking into account the deductions for supplemental wages, social insurance and overhead expenditures, respectively, in thousands of rubles;

- N_1, N_2, N_3 and N_4 are the numbers of workers at the enterprise engaged in the development of the enterprise classification system, the recoding of the information, the management of the enterprise classification system and the all-union system replacing it, respectively, in number of personnel;
- T is the time needed for the development of the enterprise classification system, in years;

  b_2, b_3 and b_4 are coefficients that take into account the working time expended on the average during a year for the recoding of the data, the management of the enterprise classification system and the all-union system replacing it, respectively;
- P_1 is the number of products presented annually by the given enterprise to the head organization for making changes in the all-union classification system;
- P_2 is the number of items presented annually by all sector enterprises to the head organization for making changes in the all-union classification system.

The development costs, Z_p, of the all-union classification system, referenced to a given enterprise, are determined as follows.

If the all-union classification system contains P positions, of which P_z positions are used in the m ASU's [management automation systems] of the given

sector, while the costs to the developing organization for the creation of this classification system were Z_{ok} thousand rubles, then the costs Z_p, referenced to the given enterprise, will be:

$$Z_p = Z_{ok}/m \tag{5}$$

The cost effectiveness coefficient, C_{rp}, from the implementation of the all--union classification system at an enterprise is defined as the ratio of the overall annual savings, E_p, in the enterprise to the expenditures, Z_p, referenced to the given enterprise:

$$C_{rp} = E_p/Z_p \tag{6}$$

Thus, if the total number of positions [items] of the all-union classification systems is P = 10,000, the number of positions used in the enterprise management automation system is P_3 = 4,000, and P_1 = 1,000 positions are annually presented by the enterprise for making changes, while the total number of changes is P_2 = 3,000 and if Z_1 = 4,000 rubles, Z_2 = 3,430 rubles, Z_3 = 3,520 rubles, Z_4 = 3,740 rubles, N_1 = N_3 = 1 person, N_2 = N_4 = 2 persons, T = 0.5 years, b_2 = b_3 = 0.5 and b_4 = 0.4, then the annual savings E_p at the enterprise as a results of implementing the all-union classification system for technical economic information will be:

$$E_p = \quad Э_п = 4 \cdot I \cdot 0{,}5 + 3{,}43 \cdot 2 \cdot 0{,}5 + 3{,}52 \cdot I \cdot 0{,}5 - \frac{1000}{3000} \cdot$$
$$\cdot 3{,}74 \cdot 2 \cdot 0{,}4 = 6{,}44 \text{ тыс. руб.} = 6{,}440 \text{ rubles}$$

If the costs of the development of the OK TEI were 87,000 rubles and there are 29 management automation systems in the sector, then the expenditures Z_p, referenced to the given enterprise, will be:

$$Z_p = 87/29 = 3{,}000 \text{ rubles}$$

The annual economic savings E_{gp} will be:

$$E_{gp} = 6{,}440 - 150 \cdot 3.0 = 5{,}990 \text{ rubles}$$

and the cost effectiveness coefficient for the implementation of this OK TEI at the enterprise will be:

$$E_{rp} = 6{,}440/3{,}000 = 2.15$$

On a sectoral scale, the annual economic savings E_{go} from the implementation of the all-union classification system is the sum of the savings for all m enterprises of the sector:

$$E_{go} = \sum_{i=1}^{m} E_{gpi} \tag{7}$$

Correspondingly, the annual savings, E_0, from the implementation of the all--union classification system on a sectoral scale will the be the sum of the annual savings for the m enterprises of the sector:

$$E_0 = \sum_{i=1}^{m} E_{pi} \qquad (8)$$

and the development costs, Z_0, for the all-union classification system, referenced to the sector, will be:

$$Z_0 = (P_3/P)Z_{ok} \qquad (9)$$

while the cost effectiveness coefficient, C_{ro}, from the implementation of the all-union classification system in the sector will be:

$$C_{ro} = E_0/Z_0 \qquad (10)$$

The procedure proposed here for the determination of the cost effectiveness of the implementation of all-union classification systems is tied to the corresponding procedure in accordance with the standardized documentation system and is directed towards assuring the uniformity of the calculations of the national economic impact of their utilization.

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III. The Management of Classification Systems and Standardized Documentation Systems

UDC 025.4:65.011.56:681.3

Trends in the Development of the Sectoral Management Automation System for Classification Systems in the Coal Industry in the 12th Five-Year Plan

[Article by K.V. Lotsmanov and B.A. Volfman, candidates of technical sciences, All-Union Scientific Research for the Coal Industry]

The creation of a sectoral management automation system for classification systems (OASVK) is one of the urgent problems and will promote uniformity in the software for the management automation system of the coal industry.

The initial loading of the database of the all-union and sectoral classifica-tion systems is accomplished within the framework of the OASVK. The structure and composition of the database are governed by user demand.

The system provides for making changes arising during task execution or in the course of production and management activity. The OASVK will support the organ-ization of a paperless technology for the transmission of current and retro-spective data, as well as communications with functional subsystems of the sectoral management automation system for the coal industry via the exchange of classification data and the organization of intersystem data exchange.

The information is accumulated at the centralized data office of the sectoral system for the classification and coding of technical economic information (TsIB OSKK), which includes the classification systems of enterprises and organ-izations, mine equipment, spare parts, etc. The total volume of stored data is more than 25 Mbytes.

The TsIB OSKK is set up in the "OKA" database management system enviroment and is physically located on two magnetic tapes.

One session for updating 1,000 items of the classification systems, including the archive entry of changes and the printout of the correction protocol re-quires about 30 minutes of machine time on the YeS 1052 computer; the selection and printout of 4,000 classification system items are accomplished in 20 minutes.

The programs and algorithms of the OASVK are in operation at 25 information computer centers of production associations, coal industry machine building plants and scientific research institutes of the coal industry.

The development of the coal industry OASVK in the 12th Five-Year Plan is to be considered in the organizational, functional, informational, software and hard-ware aspects.

The analysis of the interrelationship of the OASVK with the functional tasks encompassing the management level of a production association or mine, the analytsis of the inquiries incoming to the system from the various managed facilities, the rapidly technologies, as well as the sharp and sudden changes in the economic and social situations that lead to radical changes in manage-ment strateg- have all demonstrated the necessity of partial decentralization of the system.

Instead of a highly centralized and hierarchically ordered system for classi-fication system management, a provision is made for a distributed architecture having a homogeneous configuration relative to the centralized and grouped data bases for the conditionally conatant information and a heterogeneous con-figuration with respect to the functional databases (FBD) of the subsystems of the OASUugol [coal industry sectoral management automation system].

The homogeneous configuration provides for the same data model of the centralized and group databases, but different contents, due to the information needs of the storage center.

The heterogeneous configuration should provide for different data models for the OASVK and the subsystems of the OASU; it is necessary in this case to observe the following operational rules:

--The subsystems must have prioritized and sanctioned rules for accessing the information resources;
--The mutual access to the subsystems must be set up identically;
--The subsystems can operate independently;
--Strict conformity to overall system standards, rules and protocols must be obligatory.

Thus, the development of the OASVK within the concept of a distributed database must solve the problem of integrating inhomogeneous databases of functional subsystems of the coal industry OASU [sectoral management automation system] based on the OSKK [sectoral classification and coding system].

The existence of general principles for the management and distribution of classification systems and standards provides a basis for the application of procedural approaches to the design of the OASVK for planning the information and standards fund of the comprehensive automated system for standards (INF KASN).

It is planned that the functional capabilities of the OASVK and INF KASN will be expanded in the following directions:

--The construction of a global conceptual level for the representation of technical economic information in the management system, generated on the basis of the all-union and sectoral classification systems;
--The development of language aids on the basis of the sectoral classification system for technical, economic and social indicators (the coal industry OKTESP);
--The creation of a sectoral librar- of standards (OFN) that supports the acquisition, storage and updating of norms and standards used in the coal industry;
--Information and reference services for the end users of conditionally constant information in the "languages of business prose", belonging to the class of limited natural languages and not requiring knowledge of the utilities of the regular DBMS;
--Support of the complete sets of tasks "Accounting for and Movement of Material Resources", "Accounting for Fixed Capital", etc. of all management levels with conditionally constant information (including products and price lists);
--The datological [sic] description of the technical and economic information storage structures; this description encompasses the scheme for data representation in the database of the functional subsystems of the OASU, in the video display data, at terminals and in the local storage environment of the OASVK;

--The development of intelligent aids for accessing the data of management tasks using the coal industry OKTESP.

The concept of a distributed database provides that the conditionally constant information must be stored in the group information centers (KIB OSKK) of the information computer centers of production associations, scientific research and planning institutes. The data model of the KIB OSKK matches the data model of the TsIB OSKK [centralized information base of the sectoral classi= fication and coding system for technical economic information]. The KIB OSKK contains data circulating only at a particular management level.

The strategy for the utilization of conditionally constant information in the OASU [sectoral management automation system] is determined by the effectiveness of the solution of the functional tasks and provides for two implementation variants:

--The placing of the conditionally constant information in functional databases, and the generation of the datological description of these databases and the development of converters that enable the conversion of the conditionally constant information in the TsIB OSKK;

--The use of the TsIB or KIB [centralized or branch group information bases] of the OSKK in the execution of functional tasks by means of the utilities of the applied programmer that provide for the manipulation of conditionally constant information in the OASVK environment.

The major directions for the development of OASVK software are as follows:

--The improvement of the technology for managing conditionally constant information by means of process'ng amendments to the classification systems of different structures as well as accounting for standard and unpredictable queries during one session for updating the TsIB OSKK;

--Data compression in the TsIB OSKK for the purposes of expanding the volumes of the managed facilities without substantially increasing the external memory for database storage;

--The morphological and syntactic analysis of textual information for the purpose of refining computer-aided quality control methods for the input data, facilitating accessing of the classification system items using fragments of designations as well as developing man-machine procedures for recoding technical economic information from local representations into the OSKK environment, etc.

The hardware base on which the OASVK will be developed is a sectoral network of computer centers equipped with data transmission aids that are used in the coal industry sectoral management automation system.

8225
CSO: 1863/59

UDC 65.012.16

FEEDBACK IN ITERATIVE EXPERT PROCEDURES

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 7, Jul 86 (manuscript received 6 May 85) pp 97-103

[Article by M.V. Shneyderman, Moscow]

[Abstract] Multistage expert estimate procedures, in which experts in each stage are provided with information concerning the results of the work of all experts in previous stages, are widely used. This article presents an experimental comparison of three different types of such feedback. The information fed back to the experts may be entirely quantitative, a numerical expression of the mean values and dispersion of estimates provided by all experts in the previous round, qualitative, in which the basis given by each expert for his estimate of the previous round is presented without presenting the actual numerical value of the estimates, and "mixed," in which both types of information are provided. The mixed feedback yields the most accurate expert estimates in the test. Quantitative and mixed feedback are much stronger than qualitative feedback in stimulating experts to change their estimates from round to round. Estimates are most uniform in systems in which quantitative feedback is used, less with mixed feedback and least with qualitative feedback. The experts themselves give clear preference to mixed feedback as the most effective stimulus to improving the accuracy of their answers. References 7: 5 Russian, 2 Western.

6508/13046
CSO: 1863/178

UDC 65.01

PROBABLISTIC SELECTION OF ALTERNATIVES

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 6, Jun 86 (manuscript received 3 Jun 85) pp 5-24

[Article by R.P. Sheynin, Moscow]

[Abstract] This review attempts to collect into a single article and analyze from a single point of view the major results obtained in the last 20-25 years

by various scientists in the area of construction and analysis of models of probablistic selections by decision makers. Proofs are presented when possible for the major assertions. References 20: 2 Russian, 18 Western.

6508/13046
CSO: 1863/176A

UDC 62-505:661.17

INTERCONNECTION OF OPERATIONAL CONTROL OF PRODUCTION AND LOCAL OPTIMIZATION OF INSTALLATIONS AT ENTERPRISES WITH CONTINUOUS PRODUCTION PROCESSES

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 6, Jun 86 (manuscript received 30 May 85) pp 135-146

[Article by V.G. Gaytsgori, E.L. Itskovich, A.A. Pervozvanskiy and L.P. Sorkin, Dushanbe, Moscow, Leningrad]

[Abstract] A study is made of a class of production facilities including chemical process installations interconnected by streams of material, either directly or through intermediate storage containers. Each installation operates in the continuous mode, outputting a certain set of intermediate products, chemical compounds. Controlling actions include variation of the raw materials flow rate, temperature, pressure and other variable energy factors. Static optimal control of such a facility can be determined by solving the problem of operational control, selecting values of the major controls, while simultaneously solving the problem of local static optimization of the individual parts of the facility. Figures 2; references 11: 8 Russian, 3 Western.

6508/13046
CSO: 1863/176A

UDC 621.865.8

MODELS OF SERVICING MACHINE TOOLS IN FLEXIBLE PRODUCTION SYSTEMS

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 6, Jun 86 (manuscript received 8 Apr 85) pp 147-155

[Article by Ya.A. Kogan, L.Yu. Lishinskiy and N.V. Paradizov, Moscow]

[Abstract] There are two major principles of servicing machines in flexible production systems: one or more transportation devices, servicing both storage between operations and accumulators next to the machines; and one or more transportation devices, with one type of transportation device servicing the storage areas, another servicing the machines, and interaction between the two types of storage areas serviced by additional storage accumulators. Queuing models are suggested allowing estimation of the quality of functioning

of both types of systems. The models and methods presented are intended to investigate flexible automated processes in the early stages of planning. Therefore, certain simplifying assumptions and approximations are made. Use of the models developed allows significant reduction of the area within which optimal decisions must be sought, and permits the production of estimates of basic system characteristics for further plan development using simulation models. A numerical example is presented. Figures 5; references 4: 3 Russian, 1 Western.

6508/13046
CSO: 1863/176A

BRIEFS

BRIZ AUTOMATED SYSTEM--The Briz automated system, which accelerates the periods of introduction of innovator proposals, has begun to operate at the Motor Construction Association at Andropov. Computer hardware took on control of the innovator activity of the collective. The computer memory contains data about creative developments, their effectiveness and deadlines for completion of jobs. Information about any violations in consideration and introduction of proposals arrive currently in a specially developed monitoring service. Development of the ASU Briz is only part of the integrated plant automation program based on flexible systems, developed at the association. Implementation of it will permit a significant increase of the volume of product output. [Text] [Minsk NARODNOYE KHOZYAYSTVO BELORUSSII No 11, Nov 86] [COPYRIGHT: "Narodnoye khozyaystvo Belorussii", 11, 1986] 6521

COMPUTERS IN MACHINE BUILDING--Machine tools of the "machining center" type at the Minsk Motor Vehicle Plant have rapidly acquired the capability of restructuring to manufacture new products. An automated program preparation system for these complexes has become operational here. The use of computer hardware appreciably simplified this process and increased the labor productivity of the programmers almost tenfold. The shift factor of the equipment and product quality were also improved. The new technology completely eliminates errors in compilation of technical assignments and the idle times of machine tools for correction of programs are eliminated. [By A. Taranda] [Text] [Minsk NARODNOYE KHOZYAYSTVO BELORUSSII, No 11, Nov 86 p 17] [COPYRIGHT: "Narodnoye khozyaystvo Belorussi", 11, 1986] 6521

CSO: 1863/163

UDC 519.283

DIFFERENTIAL MIXED STRATEGY GAME

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 10, Oct 86 (manuscript received 18 Jun 85) pp 32-45

[Article by A.N. Yermolov, B.S. Kryakovskiy and Ye.P. Maslov, Moscow, Leningrad]

[Abstract] A study is made of a differential pursuit-evasion game on a plane. The pursuer and evader move with limited speeds, both being capable of arbitrary changes in direction at any time. The task of the pursuer is to approach the evader to a distance less than a fixed value, while the evader attempts to avoid this. The problem is solved assuming that the players move at constant velocities, the pursuer having a speed greater than the evader. It is assumed that the pursuer follows straight-line trajectories between moments when his direction changes. Optimal mixed strategies are determined for both players, and the value of the game is computed. There is no limit to the area of the plane or the time of the game. Figures 6; references 13: 10 Russian, 3 Western.

6508/13046
CSO: 1863/187

UDC 52-501.45

SYNTHESIS OF CLASS OF RIGIDLY STRUCTURED AUTOMATIC CONTROL SYSTEM WITH ADAPTIVE PROPERTIES. PART II. METHODS OF SYNTHESIS OF CONTROL SYSTEM STRUCTURE FOR SINGLY CONNECTED AND OBJECTS WITH MULTIPLE CONNECTIONS

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 10, Oct 86 (manuscript received 23 May 85) pp 46-55

[Article by L.D. Lozinskiy and M.V. Meyerov, Moscow]

[Abstract] The first part of this work studied the asymptotic properties of the roots of the characteristic equation of a control system which is stable with unlimited increase in regulator gain. It was assumed that the characteristic equation is an interval equation, i.e., its coefficients are assigned by their upper and lower limits. A method was found for approaching

infinite regulator gain allowing maximum weakening of limitations to the boundary. This work applies these results to the synthesis of the structure of the control system for singly connected and multiply connected objects and indicates a method of bringing regulator gain close to infinity depending on the type of structure allowing the production of adaptive properties at the asymptote as gain approaches infinity. The actual value of gain for which the difference between the initial and degenerate system becomes negligible depends on the properties of the object and may be quite small. Figures 6; references 2: Russian.

6508/13046
CSO: 1863/187

UDC 65.01

SEGMENTATION OF IMAGES BY COVERING THE PLANE WITH VORONOY POLYGONS

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 10, Oct 86 (manuscript received 10 Feb 86) pp 95-100

[Article by O.S. Agaronyan, Moscow]

[Abstract] Image segmentation is an important part of two-dimensional image analysis. Segmentation problems are encountered in many biomedical studies including diagnosis of lung disease and automatic classification of white blood cells. Texture is an important characteristic of various image areas. This article utilizes the statistical approach rather than the structural approach to textural classification, assuming that the segments of the image are random fields with various statistical properties. The task of segmentation is defined considering its statistical sense as subdivision of the image into connected areas with different statistical characteristics (texture). A mathematical model is suggested for the texture of an image in the form of a Voronoy mosaic with unknown parameters. Bayes methods are used to estimate the parameters. The image analysis method suggested is optimal with fixed a priori information and easily implemented since one must only estimate the core and brightness of the polygons which cover the plane and subsequently calculate the coordinates of the points using simple equations, rather than classifying each point on the plane. The number of points to be determined is not great, since each point is common to several polygons. Figures 3; references 9: 4 Russian, 5 Western.

6508/13046
CSO: 1863/187

UDC 65.01:681.3

SYNTHESIS OF MULTISTEP SELECTION SCHEMES

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 10, Oct 86 (manuscript received 11 Jul 85) pp 115-126

[Article by L.A. Shlomov and D.B. Yudin, Moscow]

[Abstract] Constructive methods have been suggested for many decision-making problems, including mathematical programming and optimal control techniques. However, even relatively simple control problems such as automation of the decisions of an experienced operator or technical or medical diagnosis frequently cannot be solved by machine. The area of use of computers in decision making could be expanded if the knowledge base includes selection functions formulated on the basis of observation of the actions of experienced specialists. Any selection function can be implemented by multistep generalized mathematical programming. However, the volume of a real knowledge base is limited and the number of situations in which decisions must be made is virtually unlimited, meaning that prediction of selection functions in situations never yet observed requires approximation of experimental selection functions with a multistep generalized mathematical programming scheme using a small number of steps. This article presents the constructive discussion of this problem. The results systematized in the article may be useful for the formation of knowledge bases and decision making in expert system. An example of practical application is presented. References 13: 12 Russian, 1 Western.

6508/13046
CSO: 1863/187

UDC 62-50:681.3.06

AUTOMATION OF LINEAR ANALYSIS OF CONTINUOUS CONTROL SYSTEMS

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 10, Oct 86 (manuscript received 19 Jul 85) pp 157-168

[Article by M.Kh. Dorri, N.Yu. Milovanova and E.M. Solnechnyy, Moscow]

[Abstract] Algorithms are described for linearizing equations and calculation of the frequency characteristics, transfer and weight functions used for analysis of a control system. The algorithms are implemented in the "RADIUS-TWO" program system ("RADIUS" is an acronym for the Russian words meaning "design of dynamic control systems"). The "RADIUS-TWO" system facilitates input of information and print out of results. Examples of utilization of the software are presented. Figures 6; references 10: 9 Russian, 1 Western.

6508/13046
CSO: 1863/187

UDC 518

COMPUTATION ASPECTS OF A MODIFIED ALGORITHM FOR CONSTRUCTING SEQUENCES OF PLANS FOR DISCRETE OPTIMIZATION

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 122, No 3, Jun 86 (manuscript received 1 Mar 84) pp 505-508

[Article by Z.Sh. Puturidze, Georgian Academy of Sciences, Institute of Computational Mathematics imeni N.I. Muskhelishvili]

[Abstract] Given a matrix B_τ of dimensionality $\langle S_\tau \times m_0 \rangle$, where $\tau = \overline{1,m}$, the elements of which take on values of 0 or 1, with a nonnegative weight $C_{\tau p}$ assigned for each row in the matrix, assuming that the rows are ordered in increasing value of row weight and representing a row of the matrix B_τ as b_τ, the matrix $\hat{B}=(b_1, b_2, \ldots, b_m)$ of dimensionality $(m \times m_0)$, where $b_\tau \in B_\tau$, the problem is to find

$$\min_{\hat{B}\in B} \sum_{\tau=1}^{m} C_\tau$$

with the limitations $a\eta\hat{B} \le a^{o}_{\eta}, \ \eta=\overline{1, \eta_0}.$

A previous work described a modified algorithm in the method of constructing sequences of plans to solve this problem. This article presents a numerical step-by-step implementation of this algorithm which reduces the memory required to solve the problem.

6508/13046
CSO: 1863/38

UDC 62-506.1

STATISTICAL LINEARIZATION AND RECURRENT DISPERSION IDENTIFICATION

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 122, No 3, Jun 86 (manuscript received 22 Jun 84) pp 509-512

[Article by F.F. Pashchenko and G.R. Bolkvadze, Georgian Academy of Sciences, Institute of Cybernetics]

[Abstract] This article studies problems of recurrent dispersion identification of a nonlinear dynamic object in the Hammerstein class, when the functional relationship between the input and output of the object are optimal. The suggested linearization method is used to produce a system of dispersion identification equations which is solved by recurrent identification algorithms. The method of statistical linearization is based on the ideal of approximation of a nonlinear transform of a linearized correlation statistically equivalent to the initial nonlinear mapping.

6508/13046
CSO: 1863/38

UDC 62-50

CONTROLLABILITY CRITERIA OF NONLINEAR SYSTEMS WITH PHASE LIMITATIONS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 290, No 1, Sep 86 (manuscript received 28 Nov 85) pp 18-22

[Article by Academician S.V. Yemelyanov, S.K. Korovin, I.G. Mamedov and S.V. Nikitin, All-Union Scientific Research Institute of Systems Research, Moscow]

[Abstract] A controllability criterion is suggested for a broad class of nonlinear dynamic systems, presenting necessary and sufficient conditions satisfying the requirement of easy testability and not requiring analytic vector fields, allowing establishment of controllability with phase limitations in a fixed class of control functions. The approach used to the analysis of controllability is constructive and indicates a method of synthesis of controls guaranteeing movement over assigned trajectories. Figures 1; references 9: 4 Russian, 5 Western.

6508/13046
CSO: 1863/37

UDC 62-506

RELAY CONTROL BASED ON ALGORITHM WITH PREDICTING MODEL

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 6, Jun 86 (manuscript received 1 Apr 85) pp 36-42

[Article by V.N. Bykov and N.Ye. Zubov, Moscow]

[Abstract] Some rudderlike control organs for vehicles such as aircraft function like relays, in that they are either on or off, as flaps are either extended or not. However, extending flaps does take a finite period of time. The speed of movement of flaps or shutters can be considered in the form of the relay control function for greater agreement with the actual physical picture of their operation. This article studies the problem of controlling a nonlinear dynamic object such as the flaps on an aircraft, suggesting a modification to the optimal control algorithm by the use of a predicting model reproducing the motion of the object in a reduced time scale. The prediction algorithm is intended to form the optimal relay control of the dynamic object. Figures 3; references 5: Russian.

6508/13046
CSO: 1863/176

UDC 62-501.52:66.013

PROBLEM OF VIBRATION STABILIZATION FOR NONLINEAR DYNAMIC SYSTEMS

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 6, Jun 86 (manuscript received 18 Apr 85) pp 62-74

[Article by A.M. Trakhtenberg, Moscow]

[Abstract] A study is made of autonomous, generally nonlinear dynamic systems characterized by a set of phase coordinates and parameters. The problem of vibration stabilization is defined as the problem of seeking periodic oscillations such that the dynamic system has a periodic solution which is asymptotically stable and close to the initial limiting trajectory. Vibration regulation does not require information on the status of the object or perturbations, which is its major difference from traditional regulation methods, but is not as universal as feedback control. References 20: 14 Russian, 6 Western.

6508/13046
CSO: 1863/176

UDC 681.3.06

CONTROL OF A PROGRAM SYSTEM IN A COMPUTER AS A VARIATION PROBLEM

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 6, Jun 86 (manuscript received 1 Feb 85) pp 156-165

[Article by G.M. Aleshenko, Moscow]

[Abstract] A study is made of the probablistic statement of the problem of controlling program blocks. The probablistic approach is selected because the set of input data upon which a program runs changes in a random fashion, and the set of input data determines which branches of the computation algorithm, which program blocks, will function in what sequence and for what period of time. Operation of a system of programs is analyzed as a multiphase cyclical queuing system. Control by this method is found to be effective and flexible. Figures 2; references 12: Russian.

6508/13046
CSO: 1863/176

UDC 65.012.122

MINIMUM PROCESSES OF LIMITED CAPACITY IN PRODUCTION NETWORKS

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 7, Jul 86 (manuscript received 14 May 85) pp 86-96

[Article by S.V. Lapshin, Chelyabinsk]

[Abstract] A study is made of a multistage production system with fixed demand for products from outside the system. Limitations on transportation and production capacity determine the organizational structure of the system and define, with other limitations, the set of permissible production processes which act as permissible controls on the system. The problem of constructing an operator whose nonmoving points coincide with the minimum permissible processes is solved. Minimum processes are determined which are of interest for production control. The case is studied in which the set of permissible processes contains a unique minimum process, which is shown to be optimal for the class of linear cost functions. Figures 2; references 4: 3 Russian, 1 Western.

6508/13046
CSO: 1863/178

UDC 65.012.122

USE OF THREE-DIMENSIONAL STOCHASTIC NETWORKS TO MODEL TRANSPORTATION PROCESS

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 7, Jul 86 (manuscript received 15 Apr 85) pp 77-85

[Article by Yu.A. Shulga, Donetsk]

[Abstract] Continuing previous studies, this article develops practical algorithms for modeling the process of transportation of passengers in a network such as a city mass transit system, in which passengers await servicing at stops, vehicles move sequentially from stop to stop, servicing at each stop a limited number of passengers, possibly less than the number waiting, and passengers who cannot get on one vehicle wait at the stop for the next vehicle. The queuing-theory method developed at the Institute of Applied Mathematics and Mechanics, Ukrainian Academy of Sciences, defines the necessary number of vehicles for satisfactory servicing by computing the lower limit of the number of vehicles to maintain a steady flow state of passengers at all stops. References 10: 9 Russian, 1 Western.

6508/13046
CSO: 1863/178

UDC 519.21:52-519

THE 'MALFUNCTION' PROBLEM FOR A POINTWISE RANDOM PROCESS

Moscow AVTOMATIKA I TELEMEKHANIKA in Russian No 7, Jul 86 (manuscript received 27 Jun 85) pp 70-76

[Article by G.I. Salov, Novosibirsk]

[Abstract] A study is made of the case arising upon remote control of a system or remote detection of objects in which the system moves or turns as required by the result of each observation before making the next observation. At a random moment in time, the statistical characteristics of the parameter being measured change or a malfunction occurs in the system, causing the time intervals between measurements to be distributed differently. The observer must determine at each moment whether a change has occurred in the probability characteristics of the sequence of intervals between measurements. An equation is described for the a posteriori probability of the moment when the change in the process occurs. References 6: 4 Russian, 2 Western.

6508/13046
CSO: 1863/178

NEW COMPUTER CENTER ESTABLISHED

[Editorial Report] Ashkhabad SOVET TURKMENISTANY in Turkmen 3 October 1986 carries on page 4 a 100-word note by I. Rozumbayev on the opening of an affiliate of the republic inter-vuz computer center at the V.I. Lenin Turkmen State Pedagogical Institute in Chardzhou. "This will be a major help in conducting practical and laboratory work and in analyzing basic scientific problems. In addition, students at general education and professional-technical schools will be able to use its services. In the final analysis this will create the possibility for them to familiarize themselves with computer technology and programming."

/13046
CSO: 1863/177-E

MOBILE COMPUTER CLASSROOMS

Moscow TELEVISION SERVICE in Russian 16 Jan 87

[Excerpts] Computer training of rural school children has started in Stavropol kray. This mobile computer classroom, in a comfortable Icarus bus fitted with state-of-the-art computers and displays, is an experimental one. On New Year's eve, this experiment was started under a comprehensive program for scientific and technical progress in agriculture, drawn up by CEMA member-countries. Having mastered how to interact with the computer, the school children go on to solving practical tasks. Lessons in such a mobile classroom can be given in the most remote rural schools. There is a wealth of work for the graduates of these schools. Electronic equipment is becoming firmly established in the countryside. The computing center of the agroindustrial committee not only collects and stores the data of many volumes in its electronic memory, but also of late the rooms of the computing center, which are filled with electronic equipment, have become training classrooms for chairmen of collective farms, directors of state farms and enterprises of the agroindustrial committee, managers of complexes, and branches, and economists. Already this year, all personal computers which appear at the work stations of specialists of rayon agroindustrial associations will be connected to the data bank of the kray agroindustrial committee.

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CSO: 1863/177-E

SCHOOL COMPUTER EQUIPMENT HIGHLIGHTED

[Editorial Report] Ashkhabad MUGALLYMLAR GAZETI in Turkmen 12 October 1986 carries on page 2 a 1,300-word article by T. Rakhmanov, chief of the work preparation, information and computer technology department of the TSSR Ministry of Education, on problems and achievements in the introduction of the computer science course into the secondary school curriculum. Textbooks for the first part of the course have been prepared both in Turkmen and Russian; for the second part, however, only Russian is now available. As far as equipment is concerned, he notes that "Agat, DVK2M, DVK1M and Yamaha computers are being used to organize practical studies in the information and computer technology course in the schools of our republic."

/13046
CSO: 1863/177-E

ENGINEERING STUDENTS LEARN TO USE COMPUTERIZED WORK STATIONS

Moscow PRAVDA in Russian 17 Nov 86 p 3

[Unattributed article]

[Text] Tallin--Persons who enter a new laboratory at the Tallin Polytechnical Institute have to put on cloth slippers. What they see in this laboratory, which just opened, is not at all display objects, but rather machines of the workplace. It is true that they are workplace machines of tomorrow's specialists, but students must learn to master them today.

One of the classes held here is called: engineer's computerized work station. Every student has his own terminal, personal memory unit, and printer. Give the computer a question and it will answer it; write a program for it, and it will check it and evaluate it. The traditional drafting board has become an anachronism here, according to students who are studying automated designing systems. They demonstrated how easily and quickly drawings are entered into the machine and how convenient it is to work with them on a display screen.

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